

## SECTION 01 01 10 - IC INFECTION CONTROL

### DESCRIPTION

- A. This section specifies the control of environmental infection control and risk assessment that the Contractor must consider for construction & renovation projects in the medical facility. It includes Precautionary management of, Inspections and Non invasive activities, small scale, short duration activities that create minimal dust. Major demolition and construction projects that generate a moderate to high levels of dust. Movement of materials and equipment, and resources that are encountered or generated by the Contractor. The Contractor is obligated to consider the specified control measures with the costs included within the various contract items of work. An *Infection Control Risk Assessment Matrix of Precautions* for construction and renovation for activities follows.

#### Step 1. Identify Construction Activity – see specification section 01 01 10 1-HR

<p><b>TYPE A</b> Minimal Fire Risk</p> <p>Consult IC if construction activity occurs in highest patient risk group</p>	<p><b>Inspection and Non-Invasive Activities.</b> Includes, but is not limited to:</p> <ul style="list-style-type: none"> <li>▪ removal of ceiling tiles for visual inspection limited to 1 tile per 50 square feet</li> <li>▪ painting (but not sanding)</li> <li>▪ wall covering, electrical trim work, minor plumbing, and activities which do not generate dust or require cutting of walls or access to ceilings other than for visual inspection.</li> <li>▪ removal of floor tile less than 25 square feet, non-ACM and no grinding or dust generating activities</li> </ul>
<p><b>TYPE B</b> Limited Fire Risk</p> <p>Consult IC if construction activity occurs in highest patient risk group</p>	<p><b>Small scale, short duration activities which create minimal dust.</b> Includes, but is not limited to:</p> <ul style="list-style-type: none"> <li>▪ installation of telephone and computer cabling</li> <li>▪ access to chase spaces</li> <li>▪ Cutting of walls or ceiling where dust migration can be controlled.</li> </ul>
<p><b>TYPE C</b> Moderate Fire Risk</p> <p><b>Consult IC if construction activity occurs in any and all patient risk group</b></p>	<p><b>Work that generates a moderate to high level of dust or requires demolition or removal of any fixed building components or assemblies.</b> Includes, but is not limited to:</p> <ul style="list-style-type: none"> <li>▪ sanding of walls for painting or wall covering</li> <li>▪ removal of floor coverings, ceiling tiles and casework</li> <li>▪ new construction or renovations over 3 days duration</li> <li>▪ major duct work, cabling activity, plumbing, piping, or electrical work</li> <li>▪ soldering or brazing operations</li> <li>▪ ANY activity that requires a burn permit</li> <li>▪ Any activity that cannot be completed within a single workshift</li> </ul>
<p><b>TYPE D</b> Significant Fire Risk</p> <p>Consult IC if construction activity occurs in any and all patient risk group</p>	<p><b>Major demolition and construction projects.</b> Includes, but is not limited to:</p> <ul style="list-style-type: none"> <li>▪ activities which require consecutive work shifts</li> <li>▪ requires heavy demolition or removal of a complete building/cabling system</li> <li>▪ New construction or renovations over 3 days duration</li> </ul>
APIC Infection Prevention Manual for Construction Renovation 2015	

B. Infection Control Risk and damage is defined as the presence of chemical, physical, or biological elements or agents which:

1. Adversely effect human health or welfare,
2. Unfavorably alter ecological balances of importance to human life.

Using the following table, *identify the Patient Risk Groups* that will be affected.  
 If more than one risk group will be affected, select the higher risk group:

**Step 2. Identify Patient Risk Group**

Low Risk	Medium Risk	High Risk	Highest Risk
<ul style="list-style-type: none"> <li>▪ Office areas</li> <li>▪ Warehouse</li> </ul>	<ul style="list-style-type: none"> <li>▪ Cardiology</li> <li>▪ Echocardiography</li> <li>▪ Endoscopy</li> <li>▪ Physical Therapy</li> <li>▪ Respiratory Therapy</li> <li>▪ Outpatient Mental Health</li> <li>▪ Outpatient Clinics</li> <li>▪ Simulation Lab</li> <li>▪ Comp and Pen</li> </ul>	<ul style="list-style-type: none"> <li>▪ Emergency Room</li> <li>▪ Laboratories (specimen)</li> <li>▪ Linen</li> <li>▪ Kitchen &amp; Canteen</li> <li>▪ Radiology/MRI</li> <li>▪ Nuclear medicine</li> <li>▪ Physical Therapy Tank Area</li> </ul>	<ul style="list-style-type: none"> <li>▪ Any area caring for immunocompromised patients</li> <li>▪ Pharmacy</li> <li>▪ Cardiac Cath Lab / EP Lab</li> <li>▪ Logistics Supply</li> <li>▪ Central Sterile Supply</li> <li>▪ Intensive Care Units</li> <li>▪ Medical / Mental Health Unit</li> <li>▪ Negative pressure isolation rooms</li> <li>▪ Oncology / Radiation Oncology</li> <li>▪ Inpatient and outpatient operating rooms</li> <li>▪ Dialysis</li> <li>▪ Surgical Units</li> <li>▪ Post Anesthesia Care Unit</li> <li>▪ APC Unit</li> <li>▪ Sterile Processing Services</li> </ul>

C. Match the *Patient Risk Group with Construction Project Type* on the following matrix to find the level of infection control activities required.

**Patient Risk Group** (*Low, Medium, High, Highest*) with the planned ...

**Construction Project Type** (*A, B, C, D*) on the following matrix, to find the ...

**Class of Precautions** (*I, II, III or IV*) or level of infection control activities required.

- 1) Infection Control approval will be required when the Construction Activity and Risk Level indicate that **Class III** or **Class IV** control procedures are necessary. Contact the VA Project engineer and the infection control officer before proceeding.

**Step 3. Identify Level of Infection Control Activities Required**

**IC Matrix - Class of Precautions: Construction Project by Patient Risk**

Patient Risk Group	Construction Project Type			
	TYPE A	TYPE B	TYPE C	TYPE D
<b>LOW</b> Risk Group	I	II	II	III/IV
<b>MEDIUM</b> Risk Group	I	II	III	IV
<b>HIGH</b> Risk Group	I	II	III/IV	IV
<b>HIGHEST</b> Risk Group	II	III/IV	III/IV	IV

**D. Description of Required Infection Control Precautions by Class**

**During Construction Project**

**Upon Completion of Project**

<b>CLASS I</b>	<ol style="list-style-type: none"> <li>1. Execute work by methods to minimize raising dust from construction operations.</li> <li>2. Immediately replace a ceiling tile displaced for visual inspection</li> </ol>	<ol style="list-style-type: none"> <li>1. Terminal cleaning upon project completion.</li> </ol>
<b>CLASS II</b>	<ol style="list-style-type: none"> <li>1. Provide active means to prevent airborne dust from dispersing into atmosphere.</li> <li>2. Water mist work surfaces to control dust while cutting.</li> <li>3. Seal unused doors with duct tape.</li> <li>4. Block off and seal air vents.</li> <li>5. Place dust mat at entrance and exit of work area</li> <li>6. *Remove or isolate HVAC system in areas where work is being performed.</li> </ol>	<ol style="list-style-type: none"> <li>1. Wipe work surfaces with disinfectant.</li> <li>2. Contain construction waste before transport in tightly covered containers.</li> <li>3. Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area.</li> <li>4. Remove isolation of HVAC system in areas where work is being performed.</li> <li>5. Terminal cleaning as needed and/or upon project completion.</li> </ol>
<b>CLASS III</b>	<ol style="list-style-type: none"> <li>1. *Remove or Isolate HVAC system in area where work is being done to prevent contamination of duct system.</li> <li>2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non-work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins.</li> <li>3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units.</li> <li>4. Contain construction waste before transport in tightly covered containers.</li> <li>5. Cover transport receptacles or carts. Tape covering unless solid lid.</li> </ol> <p>* Use window for negative HEPA air exhaust when accessible. Obtain V.A, resident engineer approval for exhausting in existing exhaust ductwork.</p>	<ol style="list-style-type: none"> <li>1. Do not remove barriers from work area until completed project is inspected by the owner's Safety Department and/or Infection Control Department and thoroughly cleaned by the owner's Environmental Services Department.</li> <li>2. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction.</li> <li>3. Vacuum work area with HEPA filtered vacuums.</li> <li>4. Wet mop area with disinfectant.</li> <li>5. Remove isolation of HVAC system in areas where work is being performed.</li> <li>6. Terminal cleaning as needed and/or upon project completion.</li> </ol>

<b>CLASS IV</b>	1. Isolate HVAC system in area where work is being done to prevent contamination of duct system.	1. Remove barrier material carefully to minimize spreading of dirt and debris associated with construction.
	2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non-work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins.	2. Contain construction waste before transport in tightly covered containers.
	3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units.	3. Cover transport receptacles or carts. Tape covering unless solid lid
	4. Seal holes, pipes, conduits, and punctures appropriately.	4. Vacuum work area with HEPA filtered vacuums.
	5. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave the work site.	5. Wet mop area with disinfectant.
	6. All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area.	6. Remove isolation of HVAC system in areas where work is being performed.
	7. Do not remove barriers from work area until completed project is inspected by the owner's Safety Department and Infection Control Department and thoroughly cleaned by the owner's Environmental Services Department.	

**Step 4. Identify the areas surrounding the project area, assessing potential impact**

Unit Below	Unit Above	Lateral	Lateral	Behind	Front
Risk Group	Risk Group	Risk Group	Risk Group	Risk Group	Risk Group

*Appendix: Identify and communicate the responsibility for project monitoring that includes infection control concerns and risks. The ICRA may be modified throughout the project Revisions must be communicated to the Project Manager.*

(Note: Renovation/construction area shall be isolated from the occupied areas during construction and shall be negative with respect to surrounding areas)

**Step 5. Identify specific site of activity eg, patient rooms, medication room, etc.**

**Step 6. Identify issues related to: ventilation, plumbing, electrical in terms of the occurrence of probable outages.**

**Step 7. Identify containment measures, using prior assessment. What types of barriers? (Eg, solids wall barriers); Will HEPA filtration be required?**

Step 8. **Consider potential risk of water damage. Is there a risk due to compromising structural integrity? (eg, wall, ceiling, roof)**

Step 9. **Work hours: Can or will the work be done during non-patient care hours?**

Step 10. **Do plans allow for adequate number of isolation/negative airflow rooms?**

Step 11. **Do the plans allow for the required number & type of handwashing sinks?**

Step 12. **Does the infection control staff agree with the minimum number of sinks for this project? (Verify against AIA Guidelines for types and area)**

Step 13. **Does the infection control staff agree with the plans relative to clean and soiled utility rooms?**

Step 14. **Plan to discuss the following containment issues with the project team. Eg, traffic flow, housekeeping, debris removal (how and when)**

695-15-118

Amendment #1

## Infection Control Construction Permit

					Permit No:	
Location of Construction:					Project Start Date:	
Project Coordinator:					Estimated Duration:	
Contractor <u>Performing</u> Work					Permit Expiration Date:	
Supervisor:					Telephone:	
YES	NO	CONSTRUCTION ACTIVITY			YES	NO
		TYPE A: <u>Inspection, non-invasive activity</u>				GROUP 1: Low Risk
		TYPE B: Small scale, short duration, moderate to <u>high</u> levels				GROUP 2: Medium Risk
		TYPE C: Activity generates moderate to high levels of dust, re Lures eater 1 work shift for <u>completion</u>				GROUP 3: Medium/high Risk
		TYPE. D: Major duration arid construction activities <u>Requiring consecutive work shifts</u>				GROUP 4: Highest Risk
CLASS I		1. Execute work by methods to minimize raising dust from construction operations. 2. Immediately replace any ceiling tile displaced for visual <u>inspection.</u>			3. Minor Demolition for Remodeling	
CLASS II		1. Provides active means to prevent air-borne dust from dispersing into atmosphere 2. Water mist work surfaces to control dust while cutting. 3. Seal unused doors with duct tape. 4. Block off and seal air vents. 5. Wipe surfaces with disinfectant.			6. Contain construction waste before transport in tightly covered containers. 7. Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area. 8. Place dust mat at entrance and exit of work area. 9. Remove or isolate HVAC system in areas where work is being <u>performed.</u>	
CLASS III		1. Obtain infection control pennit before construction begins. 2. Isolate HVAC system in area where work is being done to prevent contamination of the duct system. 3. Complete all critical barriers or implement control cube method before construction begins. 4. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 5 Do not remove barriers from work area until complete <u>project is thoroughly cleaned by Env. Services Dept.</u>			6. Vacuum work with HEPA filtered vacuums. 7. Wet mop with disinfectant 8. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction. 9. Contain construction waste before transport in tightly covered containers. 10. Cover transport receptacles or carts. Tape covering. 11. Remove or isolate HVAC svstem in areas where work is being performed/	
Class IV		1. Obtain infection control permit before construction begins. 2. Isolate HVAC= system in area where work is being done to prevent contamination of duct system. 3. Complete all critical barriers or implement control cube method before construction begins. 4. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 5. Seal holes, pipes, conduits, and punctures appropriately. 6. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave the work site.			7. All personnel entering work site are required to wear shoe covers 8. Do not remove barriers from work area until completed project is thoroughly cleaned by the Environmental Service Dept. 9. Vacuum work area with HEPA filtered vacuums. 10. Wet mop with disinfectant. 11. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction. 12. Contain construction waste before transport in tightly covered containers. 13. Cover transport receptacles or carts. Tape covering. 14. Remove or isolate HVAC system in areas where is bein done.	
Additional Requirements:						
					Exceptions/Additions to this permit Date	
Date Initials					Initials are noted b attached memoranda	
Permit Request By:					Permit Authorized By:	
Date:					Date:	

E. Apply Life Safety and standards (APIC) and the following criteria would need to be assured in order to maintain the supply air side open during Class 4 construction activity:

- The air supply is 100% fresh air and the site and adjacent areas can be kept under negative pressure at all times.
- There is no re circulated air in this section
- There is no duct work involved in this section of the demolition
- The site can never be positive to the adjacent areas (i.e. keep the negative air machines on at all times or for 1-2 hours post site work until the negative action can be maintained.
- A log is maintained to document that the negative pressure is checked and has been maintained during those hours when the negative air machines are turned off. (An alarmed device is recommended for this purpose and should be maintained and monitored by the construction personnel).

## **PART 2 - PRODUCTS, MATERIALS AND EQUIPMENT**

### **2.1 MATERIALS AND EQUIPMENT**

#### **GENERAL REQUIREMENTS**

- A. All materials shall be delivered in their original package, container or bundle bearing the name of the manufacturer and the brand name (where applicable). When transporting new materials & equipment though the hospital use 4 mil Poly sheeting encasing materials, tools and equipment or use a totally enclosed cart.
- B. Store all materials subject to damage off the ground, away from wet or damp surfaces and under cover sufficient enough to prevent damage or contamination. Flammable materials cannot be stored inside buildings. Replacement materials shall be stored outside of the regulated/work area until construction is completed.
- C. The Contractor shall not block or hinder use of buildings by patients, staff, and visitors to the VA in partially occupied buildings by placing materials/equipment in any unauthorized place.
- D. The Competent Person shall inspect for damaged, deteriorating or previously used materials. Such materials shall not be used and shall be removed from the worksite and disposed of properly.
- E. Demolition materials must be transported in totally enclosed containers.
  - 1) Demolition on above ground floors may use a window debris chute to convey materials to an enclosed dumpster that provides dust and noise control. The contractor is responsible to maintain the original appearance of the building fascia.

#### **2.1.2 NEGATIVE PRESSURE FILTRATION SYSTEM**

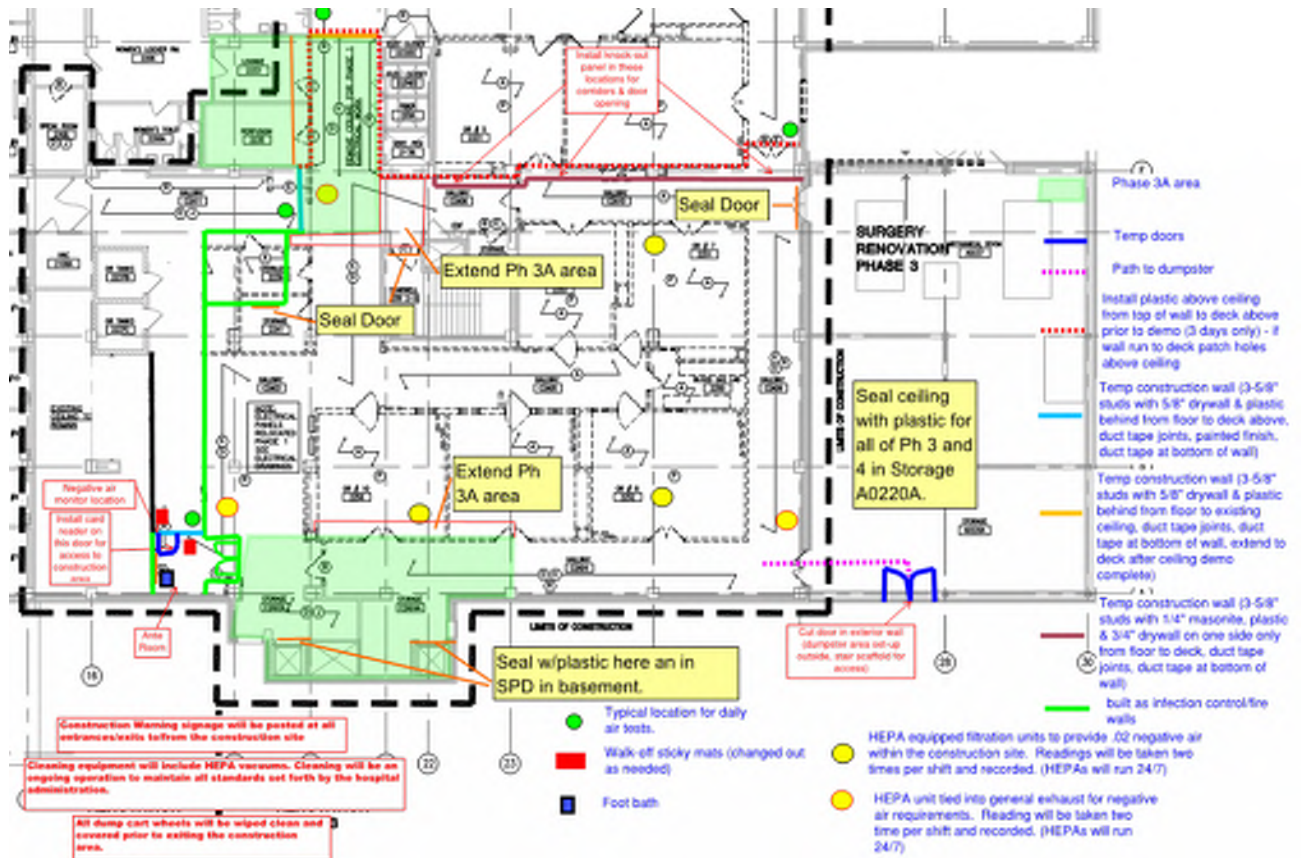
- A. The Contractor shall provide enough negative air machines to completely exchange the regulated area air volume 4 actual times per hour. The Competent Person shall determine the number of units needed for each regulated area by dividing the cubic feet in the regulated area by 15 and then dividing that result by the actual cubic feet per minute (cfm) for each unit to determine the number of units needed to effect 4 air changes per hour. Provide a standby unit in the event of machine failure and/or emergency in an adjacent area.

#### **2.1.3 DESIGN AND LAYOUT**

- A. **Before start of work for each phase of the project**, the contractor is to submit for approval, an infection control plan which will include the design and layout of the regulated area to include the type and location of infection control construction barriers to be used, access points, ante room location, etc. The submittal shall indicate the number of, location of and size of negative air machines and exhaust route & location of the windows to be used. The point(s) of exhaust, air flow within the regulated area, anticipated negative pressure differential, and supporting calculations for sizing shall be provided. In addition, submit the following:



- B. Manufacturer's information on the negative air machine(s).
- C. Method of supplying power to the units and designation/location of the panels.
- D. Description of testing method(s) for correct air volume and pressure differential. Provide manufacturer's product data on the pressure differential measuring device used.
- E. If auxiliary power supply is to be provided for the negative air machines, provide a schematic diagram of the power supply and manufacturer's data on the generator and switch.
- F. Location of isolation negative air pressure monitor.
- G. The following is a SAMPLE plan:



SAMPLE INFECTION CONTROL PLAN

## 2.1.4 NEGATIVE AIR MACHINES

- A. Negative Air Machine Cabinet: The cabinet shall be constructed of steel or other durable material capable of withstanding potential damage from rough handling and transportation. The width of the cabinet shall be less than 30" in order to fit in standard doorways. The cabinet must be factory sealed to prevent dust from being released during use, transport, or maintenance. Any access to and replacement of filters shall be from the inlet end. The unit must be on casters or wheels.
- B. Negative Air Machine Fan: The rating capacity of the fan must be the air moving capacity under actual operating conditions. Manufacturer's typically use "free-air" (no resistance) conditions when rating fans. The fan must be a centrifugal type fan.



C. Negative Air Machine Final Filter:

- 1) When exhausting directly to the outside from a window or penetration the filter shall be a minimum MERV 8 pleated filter media completely sealed on all edges within a structurally rigid frame.
- 2) When exhausting to a exhaust duct: the final filter shall be a HEPA filter. The filter media must be completely sealed on all edges within a structurally rigid frame. The filter shall align with a continuous flexible gasket material in the negative air machine housing to form an air tight seal. Each **HEPA** filter shall be individually tested and certified by the manufacturer to have an efficiency of not less than 99.97% when challenged with 0.3  $\mu$ m dioctylphthalate (DOP) particles. Testing shall have been done in accordance with Military Standard MIL- STD-282 and Army Instruction Manual 136-300-175A. Each filter must bear a UL586 label to indicate ability to perform under specified conditions. Each filter shall be marked with the name of the manufacturer, serial number, air flow rating, efficiency and resistance, and the direction of test air flow.

D. Negative Air Machine Pre-filters: The pre-filters, which protect the final HEPA filter by removing larger particles, are required to prolong the operating life of the HEPA filter. Two stages of pre-filtration are required. A first stage pre-filter shall be a low efficiency type for particles 10  $\mu$ m or larger. A second stage pre-filter shall have a medium efficiency effective for particles down to 5  $\mu$ m or larger. Pre-filters shall be installed either on or in the intake grid of the unit and held in place with a special housing or clamps.

F. Negative Air Machine Safety and Warning Devices: An electrical/ mechanical lockout must be provide to prevent the fan from being operated without a HEPA filter. Units must be equipped with an automatic shutdown device to stop the fan in the event of a rupture in the HEPA filter or blockage in the discharge of the fan. Warning lights are required to indicate normal operation; too high a pressure drop across filters; or too low of a pressure drop across filters.

G. Negative Air Machine Electrical: All electrical components shall be approved by the National Electrical Manufacturer's Association (NEMA) and Underwriter's Laboratories (UL). Each unit must be provided with overload protection and the motor, fan, fan housing, and cabinet must be grounded.

## 2.1.5 PRESSURE DIFFERENTIAL

- A. The fully operational negative air system within the regulated area shall continuously maintain a pressure differential of -0.02" water column. Before any disturbance of any material or building system, this shall be demonstrated to the VA by use of a pressure differential meter/manometer as required by OSHA 29 CFR 1926.1101(e)(5)(i). The Competent Person shall be responsible for providing and maintaining the negative pressure and air changes as required by OSHA and this specification.

## 2.1.6 TESTING THE SYSTEM

- A. The negative pressure system must be tested before any disturbedance. After the regulated area has been completely prepared, the decontamination units set up, and the negative air machines installed, start the units up one at a time. Demonstrate and document the operation and testing of the negative pressure system to the VA using smoke tubes and a negative pressure gauge. Testing must also be done at the start of each work shift.

## 2.1.7 DEMONSTRATION OF THE NEGATIVE AIR PRESSURE SYSTEM

- A. The demonstration of the operation of the negative pressure system to the VA shall include, but not be limited to, the following:
- 1) Contractor to install **Triatek** (Web site [www.Ttk.com](http://www.Ttk.com)) negative air isolation monitoring stations at the sites access doors or at opposite sides of the construction area check with COTR for number of units and location.

- 2) Curtains of the decontamination units move in toward regulated area.
- 3) Use smoke tubes to demonstrate air is moving across all areas in which work is to be done.
- 4) Plastic barriers and sheeting move lightly in toward the regulated area.

## **2.1.8 USE OF SYSTEM DURING CONSTRUCTION OPERATIONS**

- A. Start units before beginning any disturbance occurs. After work begins, the units shall run continuously, maintaining 4 actual air changes per hour at a negative pressure differential of 5.0 Pa (-0.02") water column, for the duration of the work until a final visual clearance and final air clearance has been completed.
- B. The negative air machines shall not be shut down for the duration of the project unless authorized by the VA, in writing.
- C. Construction work shall begin at a location closest from the units and proceed away from them. If an electric failure occurs, the Competent Person shall stop all work and not resume until power is restored and all units necessary are operating properly again.
- D. The negative air machines shall continue to run after all work is completed and until a final visual clearance and a final air, clearance has been completed for that regulated area.

## **2.2 CONTAINMENT BARRIERS AND COVERINGS IN THE REGULATED AREA**

### **2.2.1 GENERAL**

- A. Seal off the perimeter to the regulated area to completely isolate the regulated area from adjacent spaces. All surfaces in the regulated area must be covered to prevent contamination and to facilitate clean-up. Should adjacent areas become contaminated, immediately stop work and clean up the contamination at no additional cost to the Government.

### **2.2.3 CONTROLLING ACCESS TO THE REGULATED AREA**

- A. Access to the regulated area is allowed only through the personnel decontamination facility (PDF). All other means of access shall be eliminated and OSHA warning signs posted as required by OSHA. If the regulated area is adjacent to or within view of an occupied area, provide a visual barrier of opaque fire retardant poly sheeting at least 4 mils thick to prevent building occupant observation. If the adjacent area is accessible to the public, the barrier must be solid and capable of withstanding the negative pressure.

### **2.2.4 CRITICAL BARRIERS**

- A. Completely separate the regulated area from adjacent areas using fire retardant poly at least 6 mils thick and duct tape. Individually seal with two layers of 6 mil poly and duct tape all HVAC openings, cap off exhaust into the regulated area. Individually seal all lighting fixtures, clocks, doors, windows, convectors, speakers, or any other objects in the regulated area. Use care with hot/warm surfaces see fig 1.

### **2.2.5 PRIMARY BARRIERS**

- A. Temporary Construction Partitions:
  1. Install and maintain temporary construction partitions to provide separations between construction areas and adjoining areas. Construct partitions of gypsum board or treated plywood (flame spread rating of 25 or less in accordance with ASTM E84) on one side of wood or metal steel studs. Seal with one layers of 6 mil poly for a vapor barrier under gypsum or plywood. Extend the Poly through suspended ceilings to floor slab or roof. Seal penetrations at door openings, install tight-fitting yellow construction doors with self-closing devices see fig. 2 for barrier construction. Contractor to provide the construction(s) door for the project.

### **2.2.6 CONTRACTOR SPILL RESPONSE KIT**

- A. The kit should include the following:

1. Shop Vacuum.
2. Multi-Purpose Spill Control Sorbents to absorb nonaggesive liquids up to 30 gallons.
3. Sorbents pillows.
4. Pipe leak clamps for copper & steel pipe in sufficient size range and quantity base on project piping scope.
5. Bucket & mop and water resistant duct tape.

FIG. 1

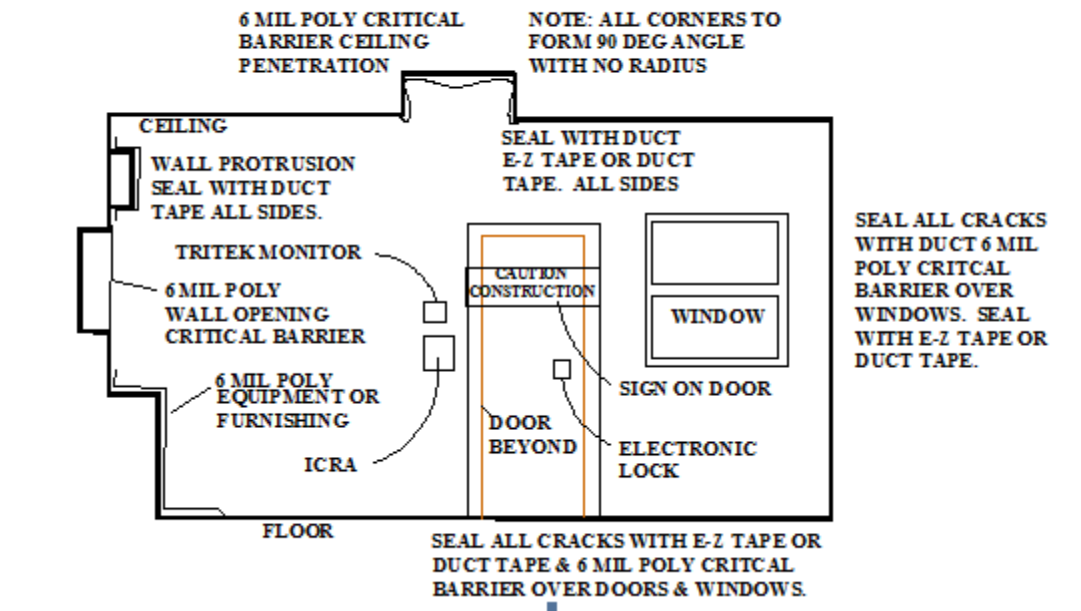


Figure 1

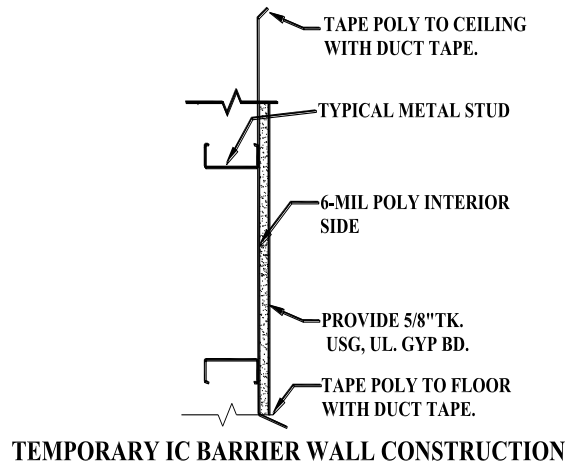


Figure 2

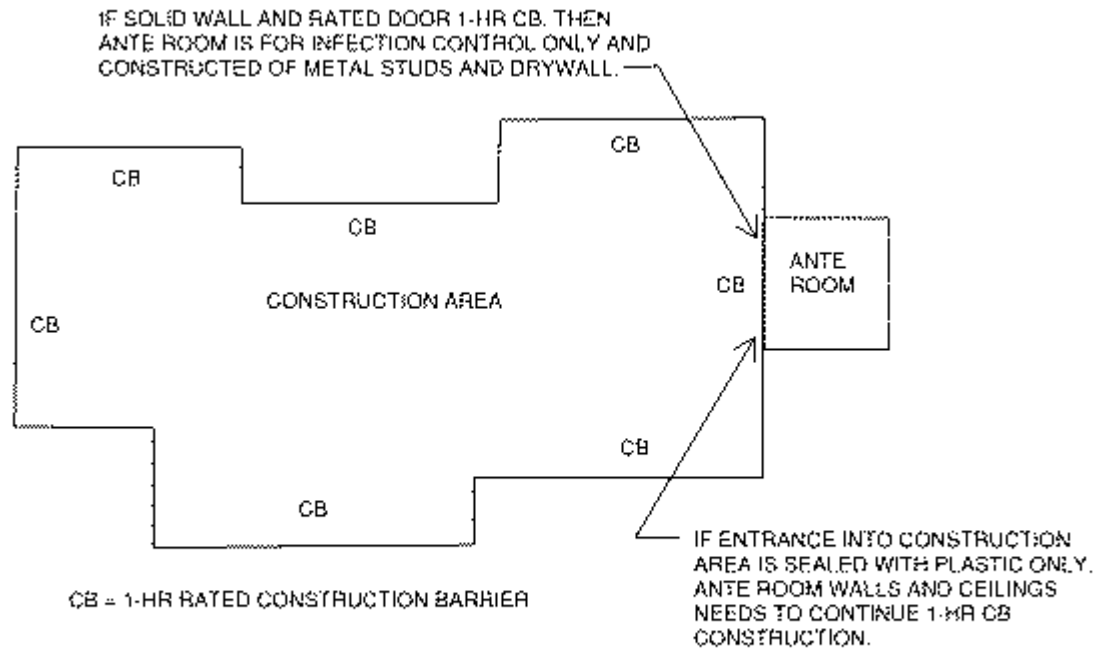


Figure 3

**Laboratory Bulk Sample Analysis Results**  
**Veteran Affairs Medical Center**  
**Bldg. 43, First Floor, A-wing North**  
**Milwaukee, Wisconsin**

<b>Sample Location</b>	<b>Sample No.</b>	<b>Material Description</b>	<b>Estimated Quantity</b>	<b>Analysis Results</b>
Room 108	43-FT-1	12" x 12" multi-colored floor tile	360 SF	None Detected
Room 108	43-FT-1 II	Black mastic from Sample 1	360 SF	5% Chrysotile
Hallway, near Room 109	43-FT-2	12" x 12" multi-colored floor tile	900 SF	None Detected
Hallway, near Room 109	43-FT-2 II	Black mastic from Sample 2	900 SF	5% Chrysotile
Room 109	43-FT-3	12" x 12" multi-colored floor tile	400 SF	None Detected
Room 109	43-FT-3 II	Black mastic from Sample 3	400 SF	5% Chrysotile
Room 107	43-FT-4	12" x 12" multi-colored floor tile	500 SF	None Detected
Room 107	43-FT-4 II	Black mastic from Sample 4	500 SF	5% Chrysotile
Room 107	43-FT-4 III	Concrete floor	-	None Detected
Room 107	43-FT-4 IV	Black mastic from Sample 4 III	-	None Detected
Hallway, near Room 106	43-FT-5	12" x 12" multi-colored floor tile	Quantity included in Sample 43-FT-2	None Detected
Hallway, near Room 106	43-FT-5 II	Black mastic from Sample 5	Quantity included in Sample 43-FT-2 II	5% Chrysotile
Hallway, near Room 106	43-FT-5 III	Concrete floor	-	None Detected
Hallway, near Room 106	43-FT-5 IV	Black mastic from Sample 5 III	-	None Detected
Room 106	43-FT-6	12" x 12" multi-colored floor tile	450 SF	None Detected
Room 106	43-FT-6 II	Black mastic from Sample 6	450 SF	5% Chrysotile

**Laboratory Bulk Sample Analysis Results**  
**Veteran Affairs Medical Center**  
**Bldg. 43, First Floor, A-wing North**  
**Milwaukee, Wisconsin**

Sample Location	Sample No.	Material Description	Estimated Quantity	Analysis Results
Room 110	43-FT-7	12" x 12" multi-colored floor tile	480 SF	None Detected
Room 110	43-FT-7 II	Black mastic from Sample 7	480 SF	5% Chrysotile
Room 111	43-FT-8	12" x 12" multi-colored floor tile	440 SF	None Detected
Room 111	43-FT-8 II	Black mastic from Sample 8	440 SF	10% Chrysotile
Room 105	43-FT-9	12" x 12" multi-colored floor tile	400 SF	None Detected
Room 105	43-FT-9 II	Black mastic from Sample 9	400 SF	7% Chrysotile
Room 104	43-FT-10	12" x 12" Tan floor tile	-	None Detected
Room 104	43-FT-10 II	Black mastic from Sample 10	-	None Detected
Room 104	43-FT-10 III	Floor filler	-	None Detected
Room 104	43-FT-10 IV	Tan mastic from Sample 4	-	None Detected
Room 104	43-FT-10 V	Black mastic from Sample 4	-	None Detected
Room 103	43-FT-11	12" x 12" Tan floor tile	150 SF	None Detected
Room 103	43-FT-11 II	Tan mastic from Sample 11	150 SF	None Detected
Room 103	43-FT-11 III	Black mastic from Sample 11	150 SF	5% Chrysotile
Room 103	43-FT-11 IV	Concrete from Sample 11	-	None Detected
Room 103	43-FT-11 V	Black mastic from Sample 11 IV	-	None Detected

**Laboratory Bulk Sample Analysis Results**  
**Veteran Affairs Medical Center**  
**Bldg. 43, First Floor, A-wing North**  
**Milwaukee, Wisconsin**

Sample Location	Sample No.	Material Description	Estimated Quantity	Analysis Results
Hallway, near Room 113	43-FT-12	12" x 12" gray floor tile	Quantity included in 43-FT-2	None Detected
Hallway, near Room 113	43-FT-12 II	Black mastic from Sample 12	Quantity included in 43-FT-2 II	7% Chrysotile
Room 100	43-FT-13	12" x 12" Tan floor tile	-	None Detected
Room 100	43-FT-13 II	Tan mastic from Sample 13	-	None Detected
Room 100	43-FT-13 III	Black mastic from Sample 13	-	None Detected
Room 100A	43-FT-14	12" x 12" multi-colored floor tile	150 SF	None Detected
Room 100A	43-FT-14 II	Black mastic from Sample 14	150 SF	7% Chrysotile
Room 100A	43-CT-15	Ceiling tile	-	None Detected
Room 100	43-CT-16	Ceiling tile	-	None Detected
Hallway, near Room 113	43-CT-17	Ceiling tile	-	None Detected
Room 103	43-CT-18	Ceiling tile	-	None Detected
Room 105	43-CT-19	Ceiling tile	-	None Detected
Room 105, bathroom	43-CT-20	Ceiling tile	-	None Detected
Room 113	43-CT-21	Ceiling tile	-	None Detected
Room 105, bathroom wall	43-CER-22	Off-white Ceramic tile	-	None Detected
Room 105, bathroom wall	43-CER-22 II	Tan mastic from Sample 22	-	None Detected
Room 105, bathroom floor	43-CER-23	Multi-colored Ceramic tile	-	None Detected



**Laboratory Bulk Sample Analysis Results**  
**Veteran Affairs Medical Center**  
**Bldg. 43, First Floor, A-wing North**  
**Milwaukee, Wisconsin**

<b>Sample Location</b>	<b>Sample No.</b>	<b>Material Description</b>	<b>Estimated Quantity</b>	<b>Analysis Results</b>
Room 105, bathroom floor	43-CER-23 II	Grout from Sample 23	-	None Detected
Room 112, bathroom wall	43-CER-24	Gray Ceramic tile	-	None Detected
Room 112, bathroom wall	43-CER-24 II	Tan mastic from Sample 24	-	None Detected
Room 112, bathroom mopboard	43-CER-25	Gray Ceramic tile	-	None Detected
Room 112, bathroom mopboard	43-CER-25 II	Tan mastic from Sample 25	-	None Detected
Room 106, bathroom wall	43-CER-26	Off-white Ceramic tile	-	None Detected
Room 106, bathroom wall	43-CER-26 II	Tan mastic from Sample 26	-	None Detected
Room 106, bathroom floor	43-CER-27	Gray Ceramic tile	-	None Detected
Room 106, bathroom floor	43-CER-27 II	Grout from Sample 27	-	None Detected
Hallway, near Room 107	43-DW-28	Drywall	-	None Detected
Room 108	43-DW-29	Drywall	-	None Detected
Room 106, Bathroom	43-DW-30	Drywall	-	None Detected
Hallway, near Room 110	43-DW-31	Drywall	-	None Detected
Room 111	43-DW-32	Drywall	-	None Detected
Room 104	43-DW-33	Drywall	-	None Detected
Room 100	43-DW-34	Drywall	-	None Detected
Hallway, near Room 107	43-JC-35	Drywall joint compound	-	None Detected
Room 108	43-JC-36	Drywall joint compound	-	None Detected

**Laboratory Bulk Sample Analysis Results**  
**Veteran Affairs Medical Center**  
**Bldg. 43, First Floor, A-wing North**  
**Milwaukee, Wisconsin**

Sample Location	Sample No.	Material Description	Estimated Quantity	Analysis Results
Room 106	43-JC-37	Drywall Joint Compound	-	None Detected
Hallway, near Room 110	43-JC-38	Drywall Joint Compound	-	None Detected
Room 111	43-JC-39	Drywall Joint Compound	-	None Detected
Room 104	43-JC-40	Drywall Joint Compound	-	None Detected
Room 100	43-JC-41	Drywall Joint Compound	-	None Detected
Room 108	43-S-42	Plaster skimcoat on concrete column	-	None Detected
Room 100	43-S-43	Plaster skimcoat on concrete column	-	None Detected
Room 111	43-S-44	Plaster skimcoat on concrete column	-	None Detected
Room 104	43-BBM-45	Vinyl wall base mastic	-	None Detected
Room 111, bathroom (above ceiling)	43-C-46	Caulk on plenum wall	-	None Detected

Total quantity of confirmed ACM flooring mastic and associated ACM-contaminated floor tile is approximately 4300 SF. Included in this quantity, but not sampled, is a telephone closet, Room 102.

Note: (10-5-15) while tile/mastic in Rooms #104 and #100 did NOT test hot, because the tile/mastic are identical to hot tile/mastic elsewhere, assume that these areas are ACM as well.

All floor tile/mastic to be treated as ACM.

**SECTION 03 30 00  
CAST-IN-PLACE CONCRETE**

SPEC WRITER NOTE: Delete between // -- // if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies cast-in-place structural concrete and materials and mixes for other concrete.

**1.2 RELATED WORK:**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete roads, walks, and similar exterior site work: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

**1.3 TESTING AGENCY FOR CONCRETE MIX DESIGN:**

- A. Testing agency for the trial concrete mix design retained and reimbursed by the Contractor and approved by Resident Engineer. For all other testing, refer to Section 01 45 29 Testing Laboratory Services.
- B. Testing agency maintaining active participation in Program of Cement and Concrete Reference Laboratory (CCRL) of National Institute of Standards and Technology. // Accompany request for approval of testing agency with a copy of Report of Latest Inspection of Laboratory Facilities by CCRL.//
- C. Testing agency shall furnish equipment and qualified technicians to establish proportions of ingredients for concrete mixes.

**1.4 TOLERANCES:**

- A. Formwork: ACI 117, except the elevation tolerance of formed surfaces before removal of shores is +0 mm (+0 inch) and -20 mm (-3/4 inch).
- B. Reinforcement Fabricating and Placing: ACI 117, except that fabrication tolerance for bar sizes Nos. 10, 13, and 16 (Nos. 3, 4, and 5) (Tolerance Symbol 1 in Fig. 2.1(a), ACI, 117) used as column ties or stirrups is +0 mm (+0 inch) and -13 mm (-1/2 inch) where gross bar length is less than 3600 mm (12 feet), or +0 mm (+0 inch) and -20 mm (-3/4 inch) where gross bar length is 3600 mm (12 feet) or more.
- C. Cross-Sectional Dimension: ACI 117, except tolerance for thickness of slabs 12 inches or less is +20 mm (+3/4 inch) and - 6 mm (-1/4 inch).

Tolerance of thickness of beams more than 300 mm (12 inch) but less than 900 mm (3 feet) is +20 mm (+3/4 inch) and -10 mm (-3/8 inch).

D. Slab Finishes: ACI 117, Section 4.5.6, F-number method in accordance with ASTM E1155, except as follows:

1. Test entire slab surface, including those areas within 600 mm (2 feet) of construction joints and vertical elements that project through slab surface.
2. Maximum elevation change which may occur within 600 mm (2 feet) of any column or wall element is 6 mm (0.25 inches).
3. Allow sample measurement lines that are perpendicular to construction joints to extend past joint into previous placement no further than 1500 mm (5 feet).

#### **1.5 REGULATORY REQUIREMENTS:**

- A. ACI SP-66 - ACI Detailing Manual.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete.
- C. ACI 301 - Standard Specifications for Structural Concrete.

#### **1.6 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Shop Drawings: Reinforcing steel: Complete shop drawings
- C. Mill Test Reports:
  1. Reinforcing Steel.
  2. Cement.
- D. Manufacturer's Certificates:
  1. Abrasive aggregate.
  2. Lightweight aggregate for structural concrete.
  3. Air-entraining admixture.
  4. Chemical admixtures, including chloride ion content.
  5. Waterproof paper for curing concrete.
  6. Liquid membrane-forming compounds for curing concrete.
  7. Non-shrinking grout.
  8. Liquid hardener.
  9. Waterstops.
  10. Expansion joint filler.
  11. Adhesive binder.
- E. Testing Agency for Concrete Mix Design: Approval request including qualifications of principals and technicians and evidence of active participation in program of Cement and Concrete Reference Laboratory

(CCRL) of National Institute of Standards and Technology // and copy of report of latest CCRL, Inspection of Laboratory. //

- F. Test Report for Concrete Mix Designs: Trial mixes including water-cement // fly ash // ratio curves, concrete mix ingredients, and admixtures.
- G. Shoring and Reshoring Sequence: Submit for approval a shoring and reshoring sequence for flat slab/flat plate portions, prepared by a registered Professional Engineer. As a minimum, include timing of form stripping, reshoring, number of floors to be re-shored and timing of re-shore removal to serve as an initial outline of procedures subject to modification as construction progresses. Submit revisions to sequence, whether initiated by Resident Engineer (see FORMWORK) or Contractor.

SPEC WRITER NOTE: Delete splitting tensile strength test of lightweight concrete if no lightweight concrete, or if only used on metal deck slabs.

- H. Test reports on splitting tensile strength (Fct) of lightweight concrete.

#### **1.7 DELIVERY, STORAGE, AND HANDLING:**

- A. Conform to ACI 304. Store aggregate separately for each kind or grade, to prevent segregation of sizes and avoid inclusion of dirt and other materials.
- B. Deliver cement in original sealed containers bearing name of brand and manufacturer, and marked with net weight of contents. Store in suitable watertight building in which floor is raised at least 300 mm (1 foot) above ground. Store bulk cement // and fly ash // in separate suitable bins.
- C. Deliver other packaged materials for use in concrete in original sealed containers, plainly marked with manufacturer's name and brand, and protect from damage until used.

#### **1.8 PRE-CONCRETE CONFERENCE:**

- A. General: At least 15 days prior to submittal of design mixes, conduct a meeting to review proposed methods of concrete construction to achieve the required results.
- B. Agenda: Includes but is not limited to:
  - 1. Submittals.
  - 2. Coordination of work.
  - 3. Availability of material.

4. Concrete mix design including admixtures.
  5. Methods of placing, finishing, and curing.
  6. Finish criteria required to obtain required flatness and levelness.
  7. Timing of floor finish measurements.
  8. Material inspection and testing.
- C. Attendees: Include but not limited to representatives of Contractor; subcontractors involved in supplying, conveying, placing, finishing, and curing concrete; lightweight aggregate manufacturer; admixture manufacturers; Resident Engineer; Consulting Engineer; Department of Veterans Affairs retained testing laboratories for concrete testing and finish (F-number) verification.
- D. Minutes of the meeting: Contractor shall take minutes and type and distribute the minutes to attendees within five days of the meeting.

SPEC WRITER NOTE: Mock-up is used only with architectural exposed concrete. Check with architect for requirements. Add ACI 303.1-97 "Standard Specification for Cast-In-Place Architectural Concrete" to the Applicable Publications section.

#### **1.9 MOCK-UP:**

- A. In addition to the other specified samples and tests, construct a mock-up using the materials, reinforcing, forming system and construction methods proposed for use in exposed architectural concrete.
- B. Construct the mock-up with at least a 2.5 m by 2.5 m (8 feet by 8 feet) exposed surface and suitable foundations. Include the following where applicable: Control joints, reglets, recesses or other typical architectural details.
- C. Before casting the mock-up, submit full detailed Shop Drawings of the mock-up formwork for review by the Architect. Perform all necessary preliminary tests to ensure that concrete used for the mock-up will exactly match the approved sample in color and texture.
- D. Perform the surface treatment proposed for use on one or more areas not less than 300 mm by 300 mm (1 foot by 1 foot) on the back side of the mock-up to establish the texture of finish required by the Architect. Repeat as required until a sample satisfactory to the Architect has been obtained.
- E. Treat the finished front surface of the mock-up to produce a uniform appearance similar in every respect to the approved sample area.

- F. The completed mock-up shall be inspected by the Architect. Failure of the mock-up to match the approved sample will require the construction of further mock-ups until approval is obtained. Remove rejected mock-ups immediately.
- G. Maintain the approved mock-ups in good condition at the job site until all architectural concrete surfaces have been completed and approved by the Architect. Remove the mock-up from the site after completion of the above.

#### **1.10 APPLICABLE PUBLICATIONS:**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Concrete Institute (ACI):
  - 117-10.....Specifications for Tolerances for Concrete Construction and Materials and Commentary
  - 211.1-91(R2009).....Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
  - 211.2-98(R2004).....Standard Practice for Selecting Proportions for Structural Lightweight Concrete
  - 214R-11.....Guide to Evaluation of Strength Test Results of Concrete
  - 301-10.....Standard Practice for Structural Concrete
  - 304R-00(R2009).....Guide for Measuring, Mixing, Transporting, and Placing Concrete
  - 305.1-06.....Specification for Hot Weather Concreting
  - 306.1-90(R2002).....Standard Specification for Cold Weather Concreting
  - 308.1-11.....Specification for Curing Concrete
  - 309R-05.....Guide for Consolidation of Concrete
  - 318-11.....Building Code Requirements for Structural Concrete and Commentary
  - 347-04.....Guide to Formwork for Concrete
  - SP-66-04.....ACI Detailing Manual
- C. American National Standards Institute and American Hardboard Association (ANSI/AHA):
  - A135.4-2004.....Basic Hardboard
- D. American Society for Testing and Materials (ASTM):



A82/A82M-07.....Standard Specification for Steel Wire, Plain,  
 for Concrete Reinforcement  
 A185/185M-07.....Standard Specification for Steel Welded Wire  
 Reinforcement, Plain, for Concrete  
 A615/A615M-09.....Standard Specification for Deformed and Plain  
 Carbon Steel Bars for Concrete Reinforcement  
 A653/A653M-11.....Standard Specification for Steel Sheet, Zinc  
 Coated (Galvanized) or Zinc Iron Alloy Coated  
 (Galvannealed) by the Hot Dip Process  
 A706/A706M-09.....Standard Specification for Low Alloy Steel  
 Deformed and Plain Bars for Concrete  
 Reinforcement  
 A767/A767M-09.....Standard Specification for Zinc Coated  
 (Galvanized) Steel Bars for Concrete  
 Reinforcement  
 A775/A775M-07.....Standard Specification for Epoxy Coated  
 Reinforcing Steel Bars  
 A820-11.....Standard Specification for Steel Fibers for  
 Fiber Reinforced Concrete  
 A996/A996M-09.....Standard Specification for Rail Steel and Axle  
 Steel Deformed Bars for Concrete Reinforcement  
 C31/C31M-10.....Standard Practice for Making and Curing  
 Concrete Test Specimens in the field  
 C33/C33M-11A.....Standard Specification for Concrete Aggregates  
 C39/C39M-12.....Standard Test Method for Compressive Strength  
 of Cylindrical Concrete Specimens  
 C94/C94M-12.....Standard Specification for Ready Mixed Concrete  
 C143/C143M-10.....Standard Test Method for Slump of Hydraulic  
 Cement Concrete  
 C150-11.....Standard Specification for Portland Cement  
 C171-07.....Standard Specification for Sheet Materials for  
 Curing Concrete  
 C172-10.....Standard Practice for Sampling Freshly Mixed  
 Concrete  
 C173-10.....Standard Test Method for Air Content of Freshly  
 Mixed Concrete by the Volumetric Method  
 C192/C192M-07.....Standard Practice for Making and Curing  
 Concrete Test Specimens in the Laboratory

C231-10.....Standard Test Method for Air Content of Freshly  
 Mixed Concrete by the Pressure Method  
 C260-10.....Standard Specification for Air Entraining  
 Admixtures for Concrete  
 C309-11.....Standard Specification for Liquid Membrane  
 Forming Compounds for Curing Concrete  
 C330-09.....Standard Specification for Lightweight  
 Aggregates for Structural Concrete  
 C494/C494M-11.....Standard Specification for Chemical Admixtures  
 for Concrete  
 C618-12.....Standard Specification for Coal Fly Ash and Raw  
 or Calcined Natural Pozzolan for Use in  
 Concrete  
 C666/C666M-03(R2008)....Standard Test Method for Resistance of Concrete  
 to Rapid Freezing and Thawing  
 C881/C881M-10.....Standard Specification for Epoxy Resin Base  
 Bonding Systems for Concrete  
 C1107/1107M-11.....Standard Specification for Packaged Dry,  
 Hydraulic-Cement Grout (Non-shrink)  
 C1315-11.....Standard Specification for Liquid Membrane  
 Forming Compounds Having Special Properties for  
 Curing and Sealing Concrete  
 D6-95(R2011).....Standard Test Method for Loss on Heating of Oil  
 and Asphaltic Compounds  
 D297-93(R2006).....Standard Methods for Rubber Products Chemical  
 Analysis  
 D412-06AE2.....Standard Test Methods for Vulcanized Rubber and  
 Thermoplastic Elastomers - Tension  
 D1751-04(R2008).....Standard Specification for Preformed Expansion  
 Joint Filler for Concrete Paving and Structural  
 Construction (Non-extruding and Resilient  
 Bituminous Types)  
 D4263-83(2012).....Standard Test Method for Indicating Moisture in  
 Concrete by the Plastic Sheet Method.  
 D4397-10.....Standard Specification for Polyethylene  
 Sheeting for Construction, Industrial and  
 Agricultural Applications

E1155-96(R2008).....Standard Test Method for Determining  $F_F$  Floor Flatness and  $F_L$  Floor Levelness Numbers  
 F1869-11.....Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

E. American Welding Society (AWS):

D1.4/D1.4M-11.....Structural Welding Code - Reinforcing Steel

F. Concrete Reinforcing Steel Institute (CRSI):

Handbook 2008

G. National Cooperative Highway Research Program (NCHRP):

Report On.....Concrete Sealers for the Protection of Bridge Structures

H. U. S. Department of Commerce Product Standard (PS):

PS 1.....Construction and Industrial Plywood

PS 20.....American Softwood Lumber

I. U. S. Army Corps of Engineers Handbook for Concrete and Cement:

CRD C513.....Rubber Waterstops

CRD C572.....Polyvinyl Chloride Waterstops

**PART 2 - PRODUCTS:**

**2.1 FORMS:**

- A. Wood: PS 20 free from loose knots and suitable to facilitate finishing concrete surface specified; tongue and grooved.
- B. Plywood: PS-1 Exterior Grade B-B (concrete-form) 16 mm (5/8 inch), or 20 mm (3/4 inch) thick for unlined contact form. B-B High Density Concrete Form Overlay optional.
- C. Metal for Concrete Rib-Type Construction: Steel (removal type) of suitable weight and form to provide required rigidity.
- D. Permanent Steel Form for Concrete Slabs: Corrugated, ASTM A653, Grade E, and Galvanized, ASTM A653, G90. Provide venting where insulating concrete fill is used.
- E. Corrugated Fiberboard Void Boxes: Double faced, completely impregnated with paraffin and laminated with moisture resistant adhesive, size as shown. Design forms to support not less than 48 KPa (1000 psf) and not lose more than 15 percent of their original strength after being completely submerged in water for 24 hours and then air dried.
- F. Form Lining:
  - 1. Hardboard: ANSI/AHA A135.4, Class 2 with one (S1S) smooth side)

2. Plywood: Grade B-B Exterior (concrete-form) not less than 6 mm (1/4 inch) thick.

3. Plastic, fiberglass, or elastomeric capable of reproducing the desired pattern or texture.

G. Concrete products shall comply with following standards for biobased materials:

Material Type	Percent by Weight
Concrete Penetrating Liquid	79 percent biobased material
Concrete form Release Agent	87 percent biobased material
Concrete Sealer	11 percent biobased material

The minimum-content standards are based on the weight (not the volume) of the material.

H. Form Ties: Develop a minimum working strength of 13.35 kN (3000 pounds) when fully assembled. Ties shall be adjustable in length to permit tightening of forms and not have any lugs, cones, washers to act as spreader within form, nor leave a hole larger than 20 mm (3/4 inch) diameter, or a depression in exposed concrete surface, or leave metal closer than 40 mm (1 1/2 inches) to concrete surface. Wire ties not permitted. Cutting ties back from concrete face not permitted.

## 2.2 MATERIALS:

A. Portland Cement: ASTM C150 Type I or II.

B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalies, and loss on ignition (LOI) not to exceed 5 percent.

C. Coarse Aggregate: ASTM C33.

1. Size 67 or Size 467 may be used for footings and walls over 300 mm (12 inches) thick.

2. Coarse aggregate for applied topping, encasement of steel columns, and metal pan stair fill shall be Size 7.

3. Maximum size of coarse aggregates not more than one-fifth of narrowest dimension between sides of forms, one-third of depth of slabs, nor three-fourth of minimum clear spacing between reinforcing bars.

D. Lightweight Aggregates for Structural Concrete: ASTM C330, Table 1.

Maximum size of aggregate not larger than one-fifth of narrowest dimension between forms, nor three-fourth of minimum clear distance

between reinforcing bars. Contractor to furnish certified report to verify that aggregate is sound and durable, and has a durability factor of not less than 80 based on 300 cycles of freezing and thawing when tested in accordance with ASTM C666.

E. Fine Aggregate: ASTM C33. Fine aggregate for applied concrete floor topping shall pass a 4.75 mm (No. 4) sieve, 10 percent maximum shall pass a 150  $\mu$ m (No. 100) sieve.

F. Mixing Water: Fresh, clean, and potable.

G. Admixtures:

1. Water Reducing Admixture: ASTM C494, Type A and not contain more chloride ions than are present in municipal drinking water.
2. Water Reducing, Retarding Admixture: ASTM C494, Type D and not contain more chloride ions than are present in municipal drinking water.
3. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C494, Type F or G, and not contain more chloride ions than are present in municipal drinking water.
4. Non-Corrosive, Non-Chloride Accelerator: ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. Admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory of at least one year duration using an acceptable accelerated corrosion test method such as that using electrical potential measures.
5. Air Entraining Admixture: ASTM C260.

SPEC WRITER NOTE: Microsilica is for use in very high strength concrete and/or impermeable concretes. It is more difficult to place and finish than normal concrete. Calcium nitrite is for use in high chloride susceptible areas only. Both are expensive, specialty products typically specified in parking structures and other areas of reinforced concrete subjected to deicers or water born chlorides.

6. Microsilica: Use only with prior review and acceptance of the Resident Engineer. Use only in conjunction with high range water reducer.
7. Calcium Nitrite corrosion inhibitor: ASTM C494 Type C.
8. Prohibited Admixtures: Calcium chloride, thiocyanate or admixtures containing more than 0.05 percent chloride ions are not permitted.

9. Certification: Written conformance to the requirements above and the chloride ion content of the admixture prior to mix design review.

SPEC WRITER NOTE: Where resilient covering is applied to slab on grade, utilize (0.38mm) 15mil vapor barrier for added moisture protection.

- H. Vapor Barrier: ASTM D4397, //0.25 mm (10 mil)//0.38 mm (15 mil).  
 I. Reinforcing Steel: ASTM A615, or ASTM A996, deformed, grade as shown.  
 J. Welded Wire Fabric: ASTM A185.

SPEC WRITER NOTE: A706 controls the amount of carbon and other elements in order to minimize brittle failures due to crystallization of the base metal.

- K. Reinforcing Bars to be Welded: ASTM A706.  
 L. Galvanized Reinforcing Bars: ASTM A767.  
 M. Epoxy Coated Reinforcing Bars: ASTM A775.

SPEC WRITER NOTE: A82 is used for spiral ties in columns, particularly in seismic regions.

- N. Cold Drawn Steel Wire: ASTM A82.  
 //O. Reinforcement for Concrete Fireproofing: 100 mm x 100 mm x 3.4 mm diameter (4 x 4-W1.4 x W1.4) welded wire fabric, secured in place to hold mesh 20 mm (3/4 inch) away from steel. Mesh at steel columns shall be wired to No. 10 (No. 3) vertical corner steel bars. //  
 P. Reinforcement for Metal Pan Stair Fill: 50 mm (2 inch) wire mesh, either hexagonal mesh at .8Kg/m<sup>2</sup> (3.0 pounds per square yard), or square mesh at .6Kg/m<sup>2</sup> (1.17 pounds per square yard).  
 Q. Supports, Spacers, and Chairs: Types which will hold reinforcement in position shown in accordance with requirements of ACI 318 except as specified.  
 R. Expansion Joint Filler: ASTM D1751.  
 S. Sheet Materials for Curing Concrete: ASTM C171.  
 T. Liquid Membrane-forming Compounds for Curing Concrete: ASTM C309, Type I, with fugitive dye, and shall meet the requirements of ASTM C1315. Compound shall be compatible with scheduled surface treatment, such as paint and resilient tile, and shall not discolor concrete surface.  
 U. Abrasive Aggregate: Aluminum oxide grains or emery grits.

SPEC WRITER NOTE: Use Liquid Chemical Floor Hardeners only to improve an existing soft or dusting slab. A properly

finished and cured slab does not need this treatment. This is an old technology. Liquid Densifier/Sealers are superior.

- V. Liquid Hardener and Dustproofer: Fluosilicate solution of magnesium fluosilicate or zinc fluosilicate. Magnesium and zinc may be used separately or in combination as recommended by manufacturer. Use only on exposed slab. Do not use where floor is covered with resilient flooring, paint or other finish coating.
- W. Moisture Vapor Emissions & Alkalinity Control Sealer: 100% active colorless aqueous silicate solution concrete surface.
  - 1. ASTM C1315 Type 1 Class A, and ASTM C309 Type 1 Class A, penetrating product to have no less than 34% solid content, leaving no sheen, volatile organic compound (VOC) content rating as required to suite regulatory requirements. The product shall have at least a five (5) year documented history in controlling moisture vapor emission from damaging floor covering, compatible with all finish materials.
  - 2. MVE 15-Year Warranty:
    - a. When a floor covering is installed on a below grade, on grade, or above grade concrete slab treated with Moisture Vapor Emissions & Alkalinity Control Sealer according to manufacturer's instruction, sealer manufacturer shall warrant the floor covering system against failure due to moisture vapor migration or moisture-born contaminates for a period of fifteen (15) years from the date of original installation. The warranty shall cover all labor and materials needed to replace all floor covering that fails due to moisture vapor emission & moisture born contaminates.
- X. Penetrating Sealer: For use on parking garage ramps and decks. High penetration silane sealer providing minimum 95 percent screening per National Cooperative Highway Research Program (NCHRP) No. 244 standards for chloride ion penetration resistance. Requires moist (non-membrane) curing of slab.
- Y. Non-Shrink Grout:
  - 1. ASTM C1107, pre-mixed, produce a compressive strength of at least 18 MPa at three days and 35 MPa (5000 psi) at 28 days. Furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent bearing under a 1200 mm x 1200 mm (4 foot by 4 foot) base plate.



2. Where high fluidity or increased placing time is required, furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent under an 450 mm x 900 mm (18 inch by 36 inch) base plate.

Z. Adhesive Binder: ASTM C881.

AA. Waterstops:

SPEC WRITER NOTE: Choose type of waterstop permitted from list below  
Non-moving joint: Any of the below waterstops are acceptable.  
Joints with movement: Use mechanical waterstop such as PVC or Rubber.

1. Polyvinyl Chloride Waterstop: CRD C572.
  2. Rubber Waterstops: CRD C513.
  3. Bentonite Waterstop: Flexible strip of bentonite 25 mm x 20 mm (1 inch by 3/4 inch), weighing 8.7 kg/m (5.85 lbs. per foot) composed of Butyl Rubber Hydrocarbon (ASTM D297), Bentonite (SS-S-210-A) and Volatile Matter (ASTM D6).
  4. Non-Metallic Hydrophilic: Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water shall conform to ASTM D412 as follows: Tensile strength 420 psi minimum; ultimate elongation 600 percent minimum. Hardness shall be 50 minimum on the type A durometer and the volumetric expansion ratio in in 70 deg water shall be 3 to 1 minimum.
- BB. Porous Backfill: Crushed stone or gravel graded from 25 mm to 20 mm (1 inch to 3/4 inch).
- CC. Fibers:
1. Synthetic Fibers: Monofilament or fibrillated polypropylene fibers for secondary reinforcing of concrete members. Use appropriate length and 0.9 kg/m<sup>3</sup> (3.0 lb. per cubic yard). Product shall have a UL rating.
  2. Steel Fibers: ASTM A820, Type I cold drawn, high tensile steel wire for use as primary reinforcing in slab-on-grade. Minimum dosage rate 18 kg/m<sup>3</sup> (30 lb. per cubic yard).
- DD. Epoxy Joint Filler: Two component, 100 percent solids compound, with a minimum shore D hardness of 50.
- EE. Bonding Admixture: Non-rewettable, polymer modified, bonding compound.
- FF. Architectural Concrete: For areas designated as architectural concrete on the Contract Documents, use colored cements and specially selected

aggregates as necessary to produce a concrete of a color and finish which exactly matches the designated sample panel.

### 2.3 CONCRETE MIXES:

SPEC WRITER NOTE: When architectural concrete is required using special cements, include shrinkage test results.

- A. Mix Designs: Proportioned in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318.
1. If trial mixes are used, make a set of at least 6 cylinders in accordance with ASTM C192 for test purposes from each trial mix; test three for compressive strength at 7 days and three at 28 days.
  2. Submit a report of results of each test series, include a detailed listing of the proportions of trial mix or mixes, including cement, // fly ash, // admixtures, weight of fine and coarse aggregate per m<sup>3</sup> (cubic yard) measured dry rodded and damp loose, specific gravity, fineness modulus, percentage of moisture, air content, water-cement // -fly ash // ratio, and consistency of each cylinder in terms of slump. // include dry unit weight of lightweight structural concrete.//
  3. Prepare a curve showing relationship between water-cement // -fly ash// ratio at 7-day and 28-day compressive strengths. Plot each curve using at least three specimens.
  4. If the field experience method is used, submit complete standard deviation analysis.
- B. Fly Ash Testing: Submit certificate verifying conformance with ASTM 618 initially with mix design and for each truck load of fly ash delivered from source. Submit test results performed within 6 months of submittal date. Notify Resident Engineer immediately when change in source is anticipated.
1. Testing Laboratory used for fly ash certification/testing shall participate in the Cement and Concrete Reference Laboratory (CCRL) program. Submit most recent CCRL inspection report.
- C. After approval of mixes no substitution in material or change in proportions of approval mixes may be made without additional tests and approval of Resident Engineer or as specified. Making and testing of preliminary test cylinders may be carried on pending approval of cement // and fly ash //, providing Contractor and manufacturer certify that

ingredients used in making test cylinders are the same. Resident Engineer may allow Contractor to proceed with depositing concrete for certain portions of work, pending final approval of cement // and fly ash // and approval of design mix.

- D. Cement Factor: Maintain minimum cement factors in Table I regardless of compressive strength developed above minimums. Use Fly Ash as an admixture with 20% replacement by weight in all structural work. Increase this replacement to 40% for mass concrete, and reduce it to 10% for drilled piers and caissons. //Fly ash shall not be used in high-early mix design.//

**TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE**

Concrete Strength		Non-Air-Entrained	Air-Entrained	
Min. 28 Day Comp. Str. MPa (psi)	Min. Cement kg/m <sup>3</sup> (lbs/c. yd)	Max. Water Cement Ratio	Min. Cement kg/m <sup>3</sup> (lbs/c. yd)	Max. Water Cement Ratio
35 (5000) <sup>1,3</sup>	375 (630)	0.45	385 (650)	0.40
30 (4000) <sup>1,3</sup>	325 (550)	0.55	340 (570)	0.50
25 (3000) <sup>1,3</sup>	280 (470)	0.65	290 (490)	0.55
25 (3000) <sup>1,2</sup>	300 (500)	*	310 (520)	*

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 8.3 MPa (1200 psi) in excess of f'c. For concrete strengths above 35 Mpa (5000 psi), the proposed mix design shall achieve a compressive strength 9.7 MPa (1400 psi) in excess of f'c.
2. Lightweight Structural Concrete. Pump mixes may require higher cement values.
3. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.
4. Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.

E. Maximum Slump: Maximum slump, as determined by ASTM C143 with tolerances as established by ASTM C94, for concrete to be vibrated shall be as shown in Table II.

SPEC WRITER NOTE: Refer to Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS, for slump used for concrete walks, curbs, gutters, and pavements.

**TABLE II - MAXIMUM SLUMP, MM (INCHES)\***

Type of Construction	Normal Weight Concrete	Lightweight Structural Concrete
Reinforced Footings and Substructure Walls	75mm (3 inches)	75 mm (3 inches)
Slabs, Beams, Reinforced Walls, and Building Columns	100 mm (4 inches)	100 mm (4 inches)

F. Slump may be increased by the use of the approved high-range water-reducing admixture (superplasticizer). Tolerances as established by

ASTM C94. Concrete containing the high-range-water-reducing admixture may have a maximum slump of 225 mm (9 inches). The concrete shall arrive at the job site at a slump of 50 mm to 75 mm (2 inches to 3 inches), and 75 mm to 100 mm (3 inches to 4 inches) for lightweight concrete. This should be verified, and then the high-range-water-reducing admixture added to increase the slump to the approved level.

SPEC WRITER NOTE: Check with Structural Engineer to determine whether air-entrainment will be approved for uses other than specified.

- G. Air-Entrainment: Air-entrainment of normal weight concrete shall conform with Table III. Air-entrainment of lightweight structural concrete shall conform with Table IV. Determine air content by either ASTM C173 or ASTM C231.

**TABLE III - TOTAL AIR CONTENT  
FOR VARIOUS SIZES OF COARSE AGGREGATES (NORMAL CONCRETE)**

Nominal Maximum Size of Total Air Content	Coarse Aggregate, mm (Inches) Percentage by Volume
10 mm (3/8 in).6 to 10	13 mm (1/2 in).5 to 9
20 mm (3/4 in).4 to 8	25 mm (1 in).3-1/2 to 6-1/2
40 mm (1 1/2 in).3 to 6	

**TABLE IV  
AIR CONTENT OF LIGHTWEIGHT STRUCTURAL CONCRETE**

Nominal Maximum size of Total Air Content	Coarse Aggregate, mm's (Inches) Percentage by Volume
Greater than 10 mm (3/8 in) 4 to 8	10 mm (3/8 in) or less 5 to 9

- H. High early strength concrete, made with Type III cement or Type I cement plus non-corrosive accelerator, shall have a 7-day compressive strength equal to specified minimum 28-day compressive strength for concrete type specified made with standard Portland cement.
- I. Lightweight structural concrete shall not weigh more than air-dry unit weight shown. Air-dry unit weight determined on 150 mm by 300 mm (6 inch by 12 inch) test cylinders after seven days standard moist curing followed by 21 days drying at 23 degrees C  $\pm$  1.7 degrees C (73.4  $\pm$  3 degrees Fahrenheit), and 50 (plus or minus 7) percent relative humidity. Use wet unit weight of fresh concrete as basis of control in field.

- J. Concrete slabs placed at air temperatures below 10 degrees C (50 degrees Fahrenheit) use non-corrosive, non-chloride accelerator. Concrete required to be air entrained use approved air entraining admixture. Pumped concrete, synthetic fiber concrete, architectural concrete, concrete required to be watertight, and concrete with a water/cement ratio below 0.50 use high-range water-reducing admixture (superplasticizer).
- K. Durability: Use air entrainment for exterior exposed concrete subjected to freezing and thawing and other concrete shown or specified. For air content requirements see Table III or Table IV.
- L. Enforcing Strength Requirements: Test as specified in Section 01 45 29, TESTING LABORATORY SERVICES, during the progress of the work. Seven-day tests may be used as indicators of 28-day strength. Average of any three 28-day consecutive strength tests of laboratory-cured specimens representing each type of concrete shall be equal to or greater than specified strength. No single test shall be more than 3.5 MPa (500 psi) below specified strength. Interpret field test results in accordance with ACI 214. Should strengths shown by test specimens fall below required values, Resident Engineer may require any one or any combination of the following corrective actions, at no additional cost to the Government:
1. Require changes in mix proportions by selecting one of the other appropriate trial mixes or changing proportions, including cement content, of approved trial mix.
  2. Require additional curing and protection.
  3. If five consecutive tests fall below 95 percent of minimum values given in Table I or if test results are so low as to raise a question as to the safety of the structure, Resident Engineer may direct Contractor to take cores from portions of the structure. Use results from cores tested by the Contractor retained testing agency to analyze structure.
  4. If strength of core drilled specimens falls below 85 percent of minimum value given in Table I, Resident Engineer may order load tests, made by Contractor retained testing agency, on portions of building so affected. Load tests in accordance with ACI 318 and criteria of acceptability of concrete under test as given therein.

5. Concrete work, judged inadequate by structural analysis, by results of load test, or for any reason, shall be reinforced with additional construction or replaced, if directed by the Resident Engineer.

#### **2.4 BATCHING AND MIXING:**

- A. General: Concrete shall be "Ready-Mixed" and comply with ACI 318 and ASTM C94, except as specified. Batch mixing at the site is permitted. Mixing process and equipment must be approved by Resident Engineer. With each batch of concrete, furnish certified delivery tickets listing information in Paragraph 16.1 and 16.2 of ASTM C94. Maximum delivery temperature of concrete is 38°C (100 degrees Fahrenheit). Minimum delivery temperature as follows:

Atmospheric Temperature	Minimum Concrete Temperature
-1. degrees to 4.4 degrees C (30 degrees to 40 degrees F)	15.6 degrees C (60 degrees F.)
-17 degrees C to -1.1 degrees C (0 degrees to 30 degrees F.)	21 degrees C (70 degrees F.)

1. Services of aggregate manufacturer's representative shall be furnished during the design of trial mixes and as requested by the Resident Engineer for consultation during batching, mixing, and placing operations of lightweight structural concrete. Services will be required until field controls indicate that concrete of required quality is being furnished. Representative shall be thoroughly familiar with the structural lightweight aggregate, adjustment and control of mixes to produce concrete of required quality. Representative shall assist and advise Resident Engineer.

### **PART 3 - EXECUTION**

#### **3.1 FORMWORK:**

- A. General: Design in accordance with ACI 347 is the responsibility of the Contractor. The Contractor shall retain a registered Professional Engineer to design the formwork, shores, and reshores.
- Form boards and plywood forms may be reused for contact surfaces of exposed concrete only if thoroughly cleaned, patched, and repaired and Resident Engineer approves their reuse.
  - Provide forms for concrete footings unless Resident Engineer determines forms are not necessary.



3. Corrugated fiberboard forms: Place forms on a smooth firm bed, set tight, with no buckled cartons to prevent horizontal displacement, and in a dry condition when concrete is placed.
- B. Treating and Wetting: Treat or wet contact forms as follows:
1. Coat plywood and board forms with non-staining form sealer. In hot weather, cool forms by wetting with cool water just before concrete is placed.
  2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather, cool metal forms by thoroughly wetting with water just before placing concrete.
  3. Use sealer on reused plywood forms as specified for new material.
- C. Size and Spacing of Studs: Size and space studs, wales and other framing members for wall forms so as not to exceed safe working stress of kind of lumber used nor to develop deflection greater than  $1/270$  of free span of member.
- D. Unlined Forms: Use plywood forms to obtain a smooth finish for concrete surfaces. Tightly butt edges of sheets to prevent leakage. Back up all vertical joints solidly and nail edges of adjacent sheets to same stud with 6d box nails spaced not over 150 mm (6 inches) apart.
- E. Lined Forms: May be used in lieu of unlined plywood forms. Back up form lining solidly with square edge board lumber securely nailed to studs with all edges in close contact to prevent bulging of lining. No joints in lining and backing may coincide. Nail abutted edges of sheets to same backing board. Nail lining at not over 200 mm (8 inches) on center along edges and with at least one nail to each square foot of surface area; nails to be 3d blued shingle or similar nails with thin flatheads.
- F. Architectural Liner: Attach liner as recommended by the manufacturer with tight joints to prevent leakage.
- G. Wall Form Ties: Locate wall form ties in symmetrically level horizontal rows at each line of wales and in plumb vertical tiers. Space ties to maintain true, plumb surfaces. Provide one row of ties within 150 mm (6 inches) above each construction joint. Space through-ties adjacent to horizontal and vertical construction joints not over 450 mm (18 inches) on center.
1. Tighten row of ties at bottom of form just before placing concrete and, if necessary, during placing of concrete to prevent seepage of concrete and to obtain a clean line. Ties to be entirely removed

- shall be loosened 24 hours after concrete is placed and shall be pulled from least important face when removed.
2. Coat surfaces of all metal that is to be removed with paraffin, cup grease or a suitable compound to facilitate removal.
- H. Inserts, Sleeves, and Similar Items: Flashing reglets, steel strips, masonry ties, anchors, wood blocks, nailing strips, grounds, inserts, wire hangers, sleeves, drains, guard angles, forms for floor hinge boxes, inserts or bond blocks for elevator guide rails and supports, and other items specified as furnished under this and other sections of specifications and required to be in their final position at time concrete is placed shall be properly located, accurately positioned, and built into construction, and maintained securely in place.
1. Locate inserts or hanger wires for furred and suspended ceilings only in bottom of concrete joists, or similar concrete member of overhead concrete joist construction.
  2. Install sleeves, inserts and similar items for mechanical services in accordance with drawings prepared specially for mechanical services. Contractor is responsible for accuracy and completeness of drawings and shall coordinate requirements for mechanical services and equipment.
  3. Do not install sleeves in beams, joists or columns except where shown or permitted by Resident Engineer. Install sleeves in beams, joists, or columns that are not shown, but are permitted by the Resident Engineer, and require no structural changes, at no additional cost to the Government.
  4. Minimum clear distance of embedded items such as conduit and pipe is at least three times diameter of conduit or pipe, except at stub-ups and other similar locations.
  5. Provide recesses and blockouts in floor slabs for door closers and other hardware as necessary in accordance with manufacturer's instructions.
- I. Construction Tolerances:
1. Set and maintain concrete formwork to assure erection of completed work within tolerances specified and to accommodate installation of other rough and finish materials. Accomplish remedial work necessary for correcting excessive tolerances. Erected work that exceeds specified tolerance limits shall be remedied or removed and replaced, at no additional cost to the Government.

2. Permissible surface irregularities for various classes of materials are defined as "finishes" in specification sections covering individual materials. They are to be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

### **3.2 PLACING REINFORCEMENT:**

- A. General: Details of concrete reinforcement in accordance with ACI 318 unless otherwise shown.
- B. Placing: Place reinforcement conforming to CRSI DA4, unless otherwise shown.
  1. Place reinforcing bars accurately and tie securely at intersections and splices with 1.6 mm (16 gauge) black annealed wire. // Use epoxy-coated tie wire with epoxy-coated reinforcing. // Secure reinforcing bars against displacement during the placing of concrete by spacers, chairs, or other similar supports. Portions of supports, spacers, and chairs in contact with formwork shall be made of plastic in areas that will be exposed when building is occupied. Type, number, and spacing of supports conform to ACI 318. Where concrete slabs are placed on ground, use concrete blocks or other non-corrodible material of proper height, for support of reinforcement. Use of brick or stone supports will not be permitted.
  2. Lap welded wire fabric at least 1 1/2 mesh panels plus end extension of wires not less than 300 mm (12 inches) in structural slabs. Lap welded wire fabric at least 1/2 mesh panels plus end extension of wires not less than 150 mm (6 inches) in slabs on grade.
  3. Splice column steel at no points other than at footings and floor levels unless otherwise shown.
- C. Spacing: Minimum clear distances between parallel bars, except in columns and multiple layers of bars in beams shall be equal to nominal diameter of bars. Minimum clear spacing is 25 mm (1 inch) or 1-1/3 times maximum size of coarse aggregate.
- D. Splicing: Splices of reinforcement made only as required or shown or specified. Accomplish splicing as follows:
  1. Lap splices: Do not use lap splices for bars larger than Number 36 (Number 11). Minimum lengths of lap as shown.
  2. Welded splices: Splicing by butt-welding of reinforcement permitted providing the weld develops in tension at least 125 percent of the yield strength (fy) for the bars. Welding conform to the

- requirements of AWS D1.4. Welded reinforcing steel conform to the chemical analysis requirements of AWS D1.4.
- a. Submit test reports indicating the chemical analysis to establish weldability of reinforcing steel.
  - b. Submit a field quality control procedure to insure proper inspection, materials and welding procedure for welded splices.
  - c. Department of Veterans Affairs retained testing agency shall test a minimum of three splices, for compliance, locations selected by Resident Engineer.
3. Mechanical Splices: Develop in tension and compression at least 125 percent of the yield strength ( $f_y$ ) of the bars. Stresses of transition splices between two reinforcing bar sizes based on area of smaller bar. Provide mechanical splices at locations indicated. Use approved exothermic, tapered threaded coupling, or swaged and threaded sleeve. Exposed threads and swaging in the field not permitted.
- a. Initial qualification: In the presence of Resident Engineer, make three test mechanical splices of each bar size proposed to be spliced. Department of Veterans Affairs retained testing laboratory will perform load test.
  - b. During installation: Furnish, at no additional cost to the Government, one companion (sister) splice for every 50 splices for load testing. Department of Veterans Affairs retained testing laboratory will perform the load test.
- E. Bending: Bend bars cold, unless otherwise approved. Do not field bend bars partially embedded in concrete, except when approved by Resident Engineer.
- F. Cleaning: Metal reinforcement, at time concrete is placed, shall be free from loose flaky rust, mud, oil, or similar coatings that will reduce bond.
- G. Future Bonding: Protect exposed reinforcement bars intended for bonding with future work by wrapping with felt and coating felt with a bituminous compound unless otherwise shown.

### **3.3 VAPOR BARRIER:**

- A. Except where membrane waterproofing is required, interior concrete slab on grade shall be placed on a continuous vapor barrier.
  1. Place 100 mm (4 inches) of fine granular fill over the vapor barrier to act as a blotter for concrete slab.

2. Vapor barrier joints lapped 150 mm (6 inches) and sealed with compatible waterproof pressure-sensitive tape.
3. Patch punctures and tears.

#### **3.4 SLABS RECEIVING RESILIENT COVERING**

- A. Slab shall be allowed to cure for 6 weeks minimum prior to placing resilient covering. After curing, slab shall be tested by the Contractor for moisture in accordance with ASTM D4263 or ASTM F1869. Moisture content shall be less than 3 pounds per 1000 sf prior to placing covering.
- B. In lieu of curing for 6 weeks, Contractor has the option, at his own cost, to utilize the Moisture Vapor Emissions & Alkalinity Control Sealer as follows:
  1. Sealer is applied on the day of the concrete pour or as soon as harsh weather permits, prior to any other chemical treatments for concrete slabs either on grade, below grade or above grade receiving resilient flooring, such as, sheet vinyl, vinyl composition tile, rubber, wood flooring, epoxy coatings and overlays.
  2. Manufacturer's representative will be on the site the day of concrete pour to install or train its application and document. He shall return on every application thereafter to verify that proper procedures are followed.
    - a. Apply Sealer to concrete slabs as soon as final finishing operations are complete and the concrete has hardened sufficiently to sustain floor traffic without damage.
    - b. Spray apply Sealer at the rate of 20 m<sup>2</sup> (200 square feet) per gallon. Lightly broom product evenly over the substrate and product has completely penetrated the surface.
    - c. If within two (2) hours after initial application areas are subjected to heavy rainfall and puddling occurs, reapply Sealer product to these areas as soon as weather condition permits.

#### **3.5 CONSTRUCTION JOINTS:**

- A. Unless otherwise shown, location of construction joints to limit individual placement shall not exceed 24,000 mm (80 feet) in any horizontal direction, except slabs on grade which shall have construction joints shown. Allow 48 hours to elapse between pouring adjacent sections unless this requirement is waived by Resident Engineer.

- B. Locate construction joints in suspended floors near the quarter-point of spans for slabs, beams or girders, unless a beam intersects a girder at center, in which case joint in girder shall be offset a distance equal to twice width of beam. Provide keys and inclined dowels as shown. Provide longitudinal keys as shown.
- C. Place concrete for columns slowly and in one operation between joints. Install joints in concrete columns at underside of deepest beam or girder framing into column.
- D. Allow 2 hours to elapse after column is cast before concrete of supported beam, girder or slab is placed. Place girders, beams, grade beams, column capitals, brackets, and haunches at the same time as slab unless otherwise shown.
- //E. Install polyvinyl chloride or rubber water seals, as shown in accordance with manufacturer's instructions, to form continuous watertight seal. //

### **3.6 EXPANSION JOINTS AND CONTRACTION JOINTS:**

- A. Clean expansion joint surfaces before installing premolded filler and placing adjacent concrete.
- //B. Install polyvinyl chloride or rubber water seals, as shown in accordance with manufacturer's instructions, to form continuous watertight seal. //
- C. Provide contraction (control) joints in floor slabs as indicated on the contract drawings. Joints shall be either formed or saw cut, to the indicated depth after the surface has been finished. Complete saw joints within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.

### **3.7 PLACING CONCRETE:**

- A. Preparation:
  - 1. Remove hardened concrete, wood chips, shavings and other debris from forms.
  - 2. Remove hardened concrete and foreign materials from interior surfaces of mixing and conveying equipment.
  - 3. Have forms and reinforcement inspected and approved by Resident Engineer before depositing concrete.
  - 4. Provide runways for wheeling equipment to convey concrete to point of deposit. Keep equipment on runways which are not supported by or bear on reinforcement. Provide similar runways for protection of vapor barrier on coarse fill.

- B. Bonding: Before depositing new concrete on or against concrete which has been set, thoroughly roughen and clean existing surfaces of laitance, foreign matter, and loose particles.
1. Preparing surface for applied topping:
    - a. Remove laitance, mortar, oil, grease, paint, or other foreign material by sand blasting. Clean with vacuum type equipment to remove sand and other loose material.
    - b. Broom clean and keep base slab wet for at least four hours before topping is applied.
    - c. Use a thin coat of one part Portland cement, 1.5 parts fine sand, bonding admixture; and water at a 50: 50 ratio and mix to achieve the consistency of thick paint. Apply to a damp base slab by scrubbing with a stiff fiber brush. New concrete shall be placed while the bonding grout is still tacky.
- C. Conveying Concrete: Convey concrete from mixer to final place of deposit by a method which will prevent segregation. Method of conveying concrete is subject to approval of Resident Engineer.
- D. Placing: For special requirements see Paragraphs, HOT WEATHER and COLD WEATHER.
1. Do not place concrete when weather conditions prevent proper placement and consolidation, or when concrete has attained its initial set, or has contained its water or cement content more than 1 1/2 hours.
  2. Deposit concrete in forms as near as practicable in its final position. Prevent splashing of forms or reinforcement with concrete in advance of placing concrete.
  3. Do not drop concrete freely more than 3000 mm (10 feet) for concrete containing the high-range water-reducing admixture (superplasticizer) or 1500 mm (5 feet) for conventional concrete. Where greater drops are required, use a tremie or flexible spout (canvas elephant trunk), attached to a suitable hopper.
  4. Discharge contents of tremies or flexible spouts in horizontal layers not exceeding 500 mm (20 inches) in thickness, and space tremies such as to provide a minimum of lateral movement of concrete.
  5. Continuously place concrete until an entire unit between construction joints is placed. Rate and method of placing concrete shall be such that no concrete between construction joints will be

- deposited upon or against partly set concrete, after its initial set has taken place, or after 45 minutes of elapsed time during concrete placement.
6. On bottom of members with severe congestion of reinforcement, deposit 25 mm (1 inch) layer of flowing concrete containing the specified high-range water-reducing admixture (superplasticizer). Successive concrete lifts may be a continuation of this concrete or concrete with a conventional slump.
  7. Concrete on metal deck:
    - a. Concrete on metal deck shall be minimum thickness shown. Allow for deflection of steel beams and metal deck under the weight of wet concrete in calculating concrete quantities for slab.
      - 1) The Contractor shall become familiar with deflection characteristics of structural frame to include proper amount of additional concrete due to beam/deck deflection.
  - E. Consolidation: Conform to ACI 309. Immediately after depositing, spade concrete next to forms, work around reinforcement and into angles of forms, tamp lightly by hand, and compact with mechanical vibrator applied directly into concrete at approximately 450 mm (18 inch) intervals. Mechanical vibrator shall be power driven, hand operated type with minimum frequency of 5000 cycles per minute having an intensity sufficient to cause flow or settlement of concrete into place. Vibrate concrete to produce thorough compaction, complete embedment of reinforcement and concrete of uniform and maximum density without segregation of mix. Do not transport concrete in forms by vibration.
    1. Use of form vibration shall be approved only when concrete sections are too thin or too inaccessible for use of internal vibration.
    2. Carry on vibration continuously with placing of concrete. Do not insert vibrator into concrete that has begun to set.

### **3.8 HOT WEATHER:**

Follow the recommendations of ACI 305 or as specified to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete. Methods proposed for cooling materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by Resident Engineer.



**3.9 COLD WEATHER:**

Follow the recommendations of ACI 306 or as specified to prevent freezing of concrete and to permit concrete to gain strength properly. Use only the specified non-corrosive, non-chloride accelerator. Do not use calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions. Methods proposed for heating materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by Resident Engineer.

**3.10 PROTECTION AND CURING:**

- A. Conform to ACI 308: Initial curing shall immediately follow the finishing operation. Protect exposed surfaces of concrete from premature drying, wash by rain and running water, wind, mechanical injury, and excessively hot or cold temperatures. Keep concrete not covered with membrane or other curing material continuously wet for at least 7 days after placing, except wet curing period for high-early-strength concrete shall be not less than 3 days. Keep wood forms continuously wet to prevent moisture loss until forms are removed. Cure exposed concrete surfaces as described below. Other curing methods may be used if approved by Resident Engineer.
  - 1. Liquid curing and sealing compounds: Apply by power-driven spray or roller in accordance with the manufacturer's instructions. Apply immediately after finishing. Maximum coverage 10m<sup>2</sup>/L (400 square feet per gallon) on steel troweled surfaces and 7.5m<sup>2</sup>/L (300 square feet per gallon) on floated or broomed surfaces for the curing/sealing compound.
  - 2. Plastic sheets: Apply as soon as concrete has hardened sufficiently to prevent surface damage. Utilize widest practical width sheet and overlap adjacent sheets 50 mm (2 inches). Tightly seal joints with tape.
  - 3. Paper: Utilize widest practical width paper and overlap adjacent sheets 50 mm (2 inches). Tightly seal joints with sand, wood planks, pressure-sensitive tape, mastic or glue.

**3.11 REMOVAL OF FORMS:**

- A. Remove in a manner to assure complete safety of structure after the following conditions have been met.
  - 1. Where structure as a whole is supported on shores, forms for beams and girder sides, columns, and similar vertical structural members may be removed after 24 hours, provided concrete has hardened

- sufficiently to prevent surface damage and curing is continued without any lapse in time as specified for exposed surfaces.
2. Take particular care in removing forms of architectural exposed concrete to insure surfaces are not marred or gouged, and that corners and arises are true, sharp and unbroken.
- B. Control Test: Use to determine if the concrete has attained sufficient strength and curing to permit removal of supporting forms. Cylinders required for control tests taken in accordance with ASTM C172, molded in accordance with ASTM C31, and tested in accordance with ASTM C39. Control cylinders cured and protected in the same manner as the structure they represent. Supporting forms or shoring not removed until strength of control test cylinders have attained at least 70 percent of minimum 28-day compressive strength specified. // For post-tensioned systems supporting forms and shoring not removed until stressing is completed. // Exercise care to assure that newly unsupported portions of structure are not subjected to heavy construction or material loading.
- C. Reshoring: Reshoring is required if superimposed load plus dead load of the floor exceeds the capacity of the floor at the time of loading. // In addition, for flat slab/plate, reshoring is required immediately after stripping operations are complete and not later than the end of the same day. // Reshoring accomplished in accordance with ACI 347 at no additional cost to the Government.

### **3.12 CONCRETE SURFACE PREPARATION:**

- A. Metal Removal: Unnecessary metal items cut back flush with face of concrete members.
- B. Patching: Maintain curing and start patching as soon as forms are removed. Do not apply curing compounds to concrete surfaces requiring patching until patching is completed. Use cement mortar for patching of same composition as that used in concrete. Use white or gray Portland cement as necessary to obtain finish color matching surrounding concrete. Thoroughly clean areas to be patched. Cut out honeycombed or otherwise defective areas to solid concrete to a depth of not less than 25 mm (1 inch). Cut edge perpendicular to surface of concrete. Saturate with water area to be patched, and at least 150 mm (6 inches) surrounding before placing patching mortar. Give area to be patched a brush coat of cement grout followed immediately by patching mortar. Cement grout composed of one part Portland cement, 1.5 parts fine sand,

bonding admixture, and water at a 50:50 ratio, mix to achieve consistency of thick paint. Mix patching mortar approximately 1 hour before placing and remix occasionally during this period without addition of water. Compact mortar into place and screed slightly higher than surrounding surface. After initial shrinkage has occurred, finish to match color and texture of adjoining surfaces. Cure patches as specified for other concrete. Fill form tie holes which extend entirely through walls from unexposed face by means of a pressure gun or other suitable device to force mortar through wall. Wipe excess mortar off exposed face with a cloth.

- C. Upon removal of forms, clean vertical concrete surface that is to receive bonded applied cementitious application with wire brushes or by sand blasting to remove unset material, laitance, and loose particles to expose aggregates to provide a clean, firm, granular surface for bond of applied finish.

SPEC WRITER NOTE: Verify requirements for finishes with Architect.

### **3.13 CONCRETE FINISHES:**

#### **A. Vertical and Overhead Surface Finishes:**

1. Unfinished areas: Vertical and overhead concrete surfaces exposed in pipe basements, elevator and dumbwaiter shafts, pipe spaces, pipe trenches, above suspended ceilings, manholes, and other unfinished areas will not require additional finishing.
2. Interior and exterior exposed areas to be painted: Remove fins, burrs and similar projections on surfaces flush, and smooth by mechanical means approved by Resident Engineer, and by rubbing lightly with a fine abrasive stone or hone. Use ample water during rubbing without working up a lather of mortar or changing texture of concrete.
3. Interior and exterior exposed areas finished: Give a grout finish of uniform color and smooth finish treated as follows:
  - a. After concrete has hardened and laitance, fins and burrs removed, scrub concrete with wire brushes. Clean stained concrete surfaces by use of a hone stone.
  - b. Apply grout composed of one part of Portland cement, one part fine sand, smaller than a 600  $\mu\text{m}$  (No. 30) sieve. Work grout into surface of concrete with cork floats or fiber brushes until all pits, and honeycombs are filled.

- c. After grout has hardened slightly, but while still plastic, scrape grout off with a sponge rubber float and, about 1 hour later, rub concrete vigorously with burlap to remove any excess grout remaining on surfaces.
  - d. In hot, dry weather use a fog spray to keep grout wet during setting period. Complete finish of area in same day. Make limits of finished areas at natural breaks in wall surface. Leave no grout on concrete surface overnight.
4. Textured: Finish as specified. Maximum quantity of patched area 0.2 m<sup>2</sup> (2 square feet) in each 93 m<sup>2</sup> (1000 square feet) of textured surface.

SPEC WRITER NOTE: Be sure that slab finish requirements are shown on the drawings.

#### B. Slab Finishes:

1. Monitoring and Adjustment: Provide continuous cycle of placement, measurement, evaluation and adjustment of procedures to produce slabs within specified tolerances. Monitor elevations of structural steel in key locations before and after concrete placement to establish typical deflection patterns for the structural steel. Determine elevations of cast-in-place slab soffits prior to removal of shores. Provide information to Resident Engineer and floor consultant for evaluation and recommendations for subsequent placements.
2. Set perimeter forms to serve as screed using either optical or laser instruments. For slabs on grade, wet screeds may be used to establish initial grade during strike-off, unless Resident Engineer determines that the method is proving insufficient to meet required finish tolerances and directs use of rigid screed guides. Where wet screeds are allowed, they shall be placed using grade stakes set by optical or laser instruments. Use rigid screed guides, as opposed to wet screeds, to control strike-off elevation for all types of elevated (non slab-on-grade) slabs. Divide bays into halves or thirds by hard screeds. Adjust as necessary where monitoring of previous placements indicates unshored structural steel deflections to other than a level profile.

3. Place slabs monolithically. Once slab placement commences, complete finishing operations within same day. Slope finished slab to floor drains where they occur, whether shown or not.
4. Use straightedges specifically made for screeding, such as hollow magnesium straightedges or power strike-offs. Do not use pieces of dimensioned lumber. Strike off and screed slab to a true surface at required elevations. Use optical or laser instruments to check concrete finished surface grade after strike-off. Repeat strike-off as necessary. Complete screeding before any excess moisture or bleeding water is present on surface. Do not sprinkle dry cement on the surface.
5. Immediately following screeding, and before any bleed water appears, use a 3000 mm (10 foot) wide highway straightedge in a cutting and filling operation to achieve surface flatness. Do not use bull floats or darbys, except that darbying may be allowed for narrow slabs and restricted spaces.
6. Wait until water sheen disappears and surface stiffens before proceeding further. Do not perform subsequent operations until concrete will sustain foot pressure with maximum of 6 mm (1/4 inch) indentation.
7. Scratch Finish: Finish base slab to receive a bonded applied cementitious application as indicated above, except that bull floats and darbys may be used. Thoroughly coarse wire broom within two hours after placing to roughen slab surface to insure a permanent bond between base slab and applied materials.
8. Float Finish: Slabs to receive unbonded toppings, steel trowel finish, fill, mortar setting beds, or a built-up roof, and ramps, stair treads, platforms (interior and exterior), and equipment pads shall be floated to a smooth, dense uniform, sandy textured finish. During floating, while surface is still soft, check surface for flatness using a 3000 mm (10 foot) highway straightedge. Correct high spots by cutting down and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections and re-float to a uniform texture.
9. Steel Trowel Finish: Concrete surfaces to receive resilient floor covering or carpet, monolithic floor slabs to be exposed to view in finished work, future floor roof slabs, applied toppings, and other interior surfaces for which no other finish is indicated. Steel

trowel immediately following floating. During final troweling, tilt steel trowel at a slight angle and exert heavy pressure to compact cement paste and form a dense, smooth surface. Finished surface shall be smooth, free of trowel marks, and uniform in texture and appearance.

10. Broom Finish: Finish exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after surfaces have been floated. Brush in a direction transverse to main traffic. Match texture approved by Resident Engineer from sample panel.
11. Finished slab flatness (FF) and levelness (FL) values comply with the following minimum requirements:
  - a. Areas covered with carpeting, or not specified otherwise in b. below:
    - 1) Slab on Grade:
 

a) Specified overall value	FF 25/FL 20
b) Minimum local value	FF 17/FL 15
    - 2) Level suspended slabs (shored until after testing) and topping slabs:
 

a) Specified overall value	FF 25/FL 20
b) Minimum local value	FF 17/FL 15
    - 3) Unshored suspended slabs:
 

a) Specified overall value	FF 25
b) Minimum local value	FF 17
    - 4) Level tolerance such that 80 percent of all points fall within a 20 mm (3/4 inch) envelope +10 mm, -10 mm (+3/8 inch, -3/8 inch) from the design elevation.
  - b. Areas that will be exposed, receive thin-set tile or resilient flooring, or roof areas designed as future floors:
    - 1) Slab on grade:
 

a) Specified overall value	FF 36/FL 20
b) Minimum local value	FF 24/FL 15
    - 2) Level suspended slabs (shored until after testing) and topping slabs
 

a) Specified overall value	FF 30/FL 20
b) Minimum local value	FF 24/FL 15
    - 3) Unshored suspended slabs:
 

a) Specified overall value	FF 30
b) Minimum local value	FF 24

4) Level tolerance such that 80 percent of all points fall within a 20 mm (3/4 inch) envelope +10 mm, -10 mm (+3/8 inch, -3/8 inch) from the design elevation.

- c. "Specified overall value" is based on the composite of all measured values in a placement derived in accordance with ASTM E1155.
- d. "Minimum local value" (MLV) describes the flatness or levelness below which repair or replacement is required. MLV is based on the results of an individual placement and applies to a minimum local area. Minimum local area boundaries may not cross a construction joint or expansion joint. A minimum local area will be bounded by construction and/or control joints, or by column lines and/or half-column lines, whichever is smaller.

## 12. Measurements

- a. Department of Veterans Affairs retained testing laboratory will take measurements as directed by Resident Engineer, to verify compliance with FF, FL, and other finish requirements. Measurements will occur within 72 hours after completion of concrete placement (weekends and holidays excluded). Make measurements before shores or forms are removed to insure the "as-built" levelness is accurately assessed. Profile data for above characteristics may be collected using a laser level or any Type II apparatus (ASTM E1155, "profileograph" or "dipstick"). Contractor's surveyor shall establish reference elevations to be used by Department of Veterans Affairs retained testing laboratory.
- b. Contractor not experienced in using FF and FL criteria is encouraged to retain the services of a floor consultant to assist with recommendations concerning adjustments to slab thicknesses, finishing techniques, and procedures on measurements of the finish as it progresses in order to achieve the specific flatness and levelness numbers.

## 13. Acceptance/ Rejection:

- a. If individual slab section measures less than either of specified minimum local  $F_F/F_L$  numbers, that section shall be rejected and remedial measures shall be required. Sectional boundaries may be set at construction and contraction (control) joints, and not smaller than one-half bay.

- b. If composite value of entire slab installation, combination of all local results, measures less than either of specified overall  $F_F/F_L$  numbers, then whole slab shall be rejected and remedial measures shall be required.
- 14. Remedial Measures for Rejected Slabs: Correct rejected slab areas by grinding, planing, surface repair with underlayment compound or repair topping, retopping, or removal and replacement of entire rejected slab areas, as directed by Resident Engineer, until a slab finish constructed within specified tolerances is accepted.

### **3.14 SURFACE TREATMENTS:**

- A. Use on exposed concrete floors and concrete floors to receive carpeting // except those specified to receive non-slip finish //.
- B. Liquid Densifier/Sealer: Apply in accordance with manufacturer's directions just prior to completion of construction.
- C. Non-Slip Finish: Except where safety nosing and tread coverings are shown, apply non-slip abrasive aggregate to treads and platforms of concrete steps and stairs, and to surfaces of exterior concrete ramps and platforms. Broadcast aggregate uniformly over concrete surface at rate of application of 8% per 1/10th m<sup>2</sup> (7.5 percent per square foot) of area. Trowel concrete surface to smooth dense finish. After curing, rub treated surface with abrasive brick and water to slightly expose abrasive aggregate.

### **3.15 APPLIED TOPPING:**

- A. Separate concrete topping on floor base slab of thickness and strength shown. Topping mix shall have a maximum slump of 200 mm (8 inches) for concrete containing a high-range water-reducing admixture (superplasticizer) and 100 mm (4 inches) for conventional mix. Neatly bevel or slope at door openings and at slabs adjoining spaces not receiving an applied finish.
- B. Placing: Place continuously until entire section is complete, struck off with straightedge, leveled with a highway straightedge or highway bull float, floated and troweled by machine to a hard dense finish. Slope to floor drains as required. Do not start floating until free water has disappeared and no water sheen is visible. Allow drying of surface moisture naturally. Do not hasten by "dusting" with cement or sand.



**3.16 RESURFACING FLOORS:**

Remove existing flooring areas to receive resurfacing to expose existing structural slab and extend not less than 25 mm (1 inch) below new finished floor level. Prepare exposed structural slab surface by roughening, broom cleaning, and dampening. Apply specified bonding grout. Place topping while the bonding grout is still tacky.

SPEC WRITER NOTE: Check Landscape Architectural Division to determine if retaining walls are to be specified in Site Work Concrete.

**3.17 RETAINING WALLS:**

- A. Use air-entrained concrete.
- B. Expansion and contraction joints, waterstops, weep holes, reinforcement and railing sleeves installed and constructed as shown.
- C. Exposed surfaces finished to match adjacent concrete surfaces, new or existing.
- D. Place porous backfill as shown.

**3.18 PRECAST CONCRETE ITEMS:**

Precast concrete items, not specified elsewhere. Cast using 25 MPa (3000 psi) air-entrained concrete to shapes and dimensions shown. Finish to match corresponding adjacent concrete surfaces. Reinforce with steel for safe handling and erection.

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**SECTION 08 31 13**  
**ACCESS DOORS AND FRAMES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Access doors and panels installed in walls and ceilings.

**1.2 APPLICABLE PUBLICATIONS**

A. Comply with references to extent specified in this section.

B. American Welding Society (AWS):

1. D1.3/D1.3M-08 - Structural Welding Code - Sheet Steel.

C. ASTM International (ASTM):

1. A653/A653M-15 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Sip Process.
2. A1008/A1008M-15 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Baked Hardenable.
3. A666-15 - Annealed or Cold-Worked Austenitic Stainless Steel sheet, Strip, Plate, and Flat Bar.
4. E119-15 - Fire Test of Building Construction and Materials.

D. National Fire Protection Association (NFPA):

1. 80-16 - Fire Doors and Other Opening Protectives.
2. 251-12 - Fire Tests of Door Assemblies.

E. National Association of Architectural Metal Manufacturers (NAAMM):

1. AMP 500-06 - Metal Finishes Manual.

F. UL LLC (UL):

1. Listed - Online Certifications Directory.
2. 10B-08 - Standard for Fire Tests of Door Assemblies.
3. 263-11 - Fire Tests of Building Construction and Materials.

**1.3 SUBMITTALS**

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Submittal Drawings:

1. Show size, configuration, and fabrication and installation details.

C. Manufacturer's Literature and Data:

1. Description of each product.
2. Installation instructions.

D. Sustainable Construction Submittals:

1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.

**1.4 DELIVERY**

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

**1.5 STORAGE AND HANDLING**

- A. Store products indoors in dry, weathertight facility.
- B. Protect products from damage during handling and construction operations.

**1.6 FIELD CONDITIONS**

- A. Field Measurements: Verify field conditions affecting access door fabrication and installation. Show field measurements on Submittal Drawings.
  1. Coordinate field measurement and fabrication schedule to avoid delay.

**1.7 WARRANTY**

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Galvanized Steel: ASTM A 653/A 653M.

**2.2 PRODUCTS - GENERAL**

- A. Provide each product from one manufacturer.
- B. Sustainable Construction Requirements:
  1. Steel Access Doors Recycled Content: 30 percent total recycled content, minimum.

**2.3 ACCESS DOOR**

- A. Door Construction:
  1. Basis of Design : Nystrom FGP3648HR
- B. LOAD: 300psf live load (pedestrian)

- C. MATERIAL: Aluminum 1/4 inch, mill finish with epoxy on exterior frame
- D. COVER: Diamond tread plate or
- E. FIRE-RATING: Not required
- F. FRAME: Angle
- G. INSTALLATION: Cast-In: 1/4 inch x 1 inch x 4 inch anchor straps welded for concrete pour
- H. Surface mount, mechanically fastened: bolt holes, 3/8 inch diameter for drop-in
- I. SPRING: Type 316 SST
- J. HINGES: Heavy-duty Type 316 SST butt hinge
- K. HOLD OPEN ARM: Type 316 Stainless Steel automatic hold open arm locks cover in open position
- L. LATCH: Slam latch, Type 316 SST, with inside pull release cable, includes removable 5/16 inch steel square "L" handle and threaded plug
- M. COMPLIANCE: NFPA 288
- N. SIZES: As indicated in drawings
- O. OPTIONS: Self-closing mechanism automatically closes door at 165°F in event of fire, dampers for slow opening
- P. Frame Flange: Provide at units installed in concrete, masonry, and gypsum board.
- Q. Lock: Flush, screwdriver operated cam lock.

#### **2.4 FABRICATION - GENERAL**

- A. Component Fabrication: Straight, square, flat and in same plane where required.
  - 1. Exposed Edges: Slightly rounded, without burrs, snags and sharp edges.
  - 2. Exposed Welds: Continuous, ground smooth.
  - 3. Welding: AWS D1.3/D1.3M.
- B. Locks and Non-Continuous Hinges: Provide in numbers required to maintain alignment of door panel with frame. For fire-rated doors, provide hinges and locks as required by fire test.
- C. Anchoring: Make provisions in frame for anchoring to adjacent construction. Provide anchors in size, number and location on four sides to secure access door to substrate. Provide anchors as required by fire test.

#### **2.5 FINISHES**

- A. Steel Paint Finish:

1. Powder-Coat Finish: Manufacturer's standard two-coat finish system consisting of the following:
  - a. One coat primer.
  - b. One coat thermosetting topcoat.
  - c. Dry-film Thickness: 0.05 mm (2 mils) minimum.
  - d. Color: Grey

## **2.6 ACCESSORIES**

- A. Fasteners: Type and size recommended by access door manufacturer, to suit application.
  1. Other Access Doors: Galvanized steel, Stainless steel fasteners.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Examine and verify substrate suitability for product installation.
  1. Verify access door locations and sizes provide required maintenance access to installed building services components.
- B. Protect existing construction and completed work from damage.

### **3.2 INSTALLATION - GENERAL**

- A. Install products according to manufacturer's instructions and approved submittal drawings.
  1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.
- B. Install access doors and panels permitting access to service valves, traps, dampers, cleanouts, and other mechanical, electrical and conveyor control items concealed in walls and partitions, and concealed above gypsum board and plaster ceilings.
- C. Install fire rated access door according to NFPA 80.

### **3.3 ACCESS DOOR AND FRAME INSTALLATION**

- A. Frames with Flanges: Overlap opening, with face uniformly spaced from finish surface.
- B. Recessed Panel Access Doors: Install with face of surrounding materials flush with door panel installed finish.
- C. Secure frames to adjacent construction with fasteners.

- D. Install type, size and quantity of anchoring device suitable for material surrounding opening to maintain alignment, and resist displacement, during normal use of access door.
- E. Field Painting Primed Access Doors: Comply with the requirements of Section 09 91 00, PAINTING.

#### **3.4 ADJUSTMENT**

- A. Adjust hardware so door panel opens freely.
- B. Adjust door when closed so door panel is centered in frame.

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## **SECTION 113100**

### **RESIDENTIAL APPLIANCES**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Refrigeration appliances.
  - 2. Cleaning appliances.

##### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Energy Star Rating certificate.
- C. Product Schedule: For appliances. Use same designations indicated on Drawings.

##### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer.
- B. Product Certificates: For each type of appliance.
- C. Field quality-control reports.
- D. Sample Warranties: For manufacturers' special warranties.

### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

### **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Maintains, within 30 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

### **1.7 WARRANTY**

- A. Refrigerator/Freezer Sealed System: Full warranty, including parts and labor, for on-site service on the product.
  - 1. Warranty Period for Sealed Refrigeration System: Five years from date of Substantial Completion.
  - 2. Warranty Period for Other Components: Two years from date of Substantial Completion.
- B. Clothes Washer: Full warranty, including parts and labor, for on-site service on the product.
  - 1. Warranty Period: Three years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Source Limitations: Obtain residential appliances from single source and each type of residential appliance from single manufacturer.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Gas-Fueled Appliances: Certified by a qualified testing agency for each type of gas-fueled appliance according to ANSI Z21 Series standards.
- C. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable



provisions in the DOJ's 2010 ADA Standards for Accessible Design, VA Barrier Free Design Guide PG-18-13, ABAAS and ICC A117.1

## **2.3 REFRIGERATOR/FREEZERS**

- A. Refrigerator/Freezer: Two-door, side-by-side and complying with AHAM HRF-1.
  - 1. Type: Freestanding.
  - 2. Dimensions: As indicated in drawings, #3 in Equipment List, page A102.
  - 3. Storage Capacity: As indicated in drawings comment #7.
  - 4. General Features:
    - a. Door Configuration: Framed.
    - b. Dual refrigeration systems.
    - c. Separate temperature controls for each compartment.
  - 5. Refrigerator Features:
    - a. Interior light in refrigeration compartment.
    - b. Compartment Storage: vegetable crisper and meat compartment.
    - c. Door Storage: Modular compartments
  - 6. Freezer Features: One freezer compartment(s) with door(s).
    - a. Automatic defrost.
    - b. Interior light in freezer compartment.
  - 7. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
  - 8. Appliance Color/Finish: Stainless Steel

## **2.4 CLOTHES WASHERS AND DRYERS**

- A. Clothes Washer: Complying with AHAM HLW-1.
  - 1. Type: Freestanding, front-loading unit as indicated in drawings, #6 in Equipment List, page A102.
  - 2. Dimensions:
    - a. Volume: As indicated in drawings.
    - b. Height: 34-1/2 inches (876 mm).
  - 3. Drum: Manufacturer's standard.
    - a. Capacity: As indicated on drawings.

4. Controls: Touch-pad for water-fill levels, wash/rinse water temperatures, and variable-speed and fabric selectors.
    - a. Wash Cycles: Four wash cycles, including regular, delicate, and permanent press.
    - b. Wash Temperatures: Three settings.
    - c. Speed Combinations: Four.
  5. Electrical Power: As indicated on Drawings.
  6. Motor: Manufacturer's standard with built-in overload protector.
  7. Features:
    - a. Agitator: Center spindle.
    - b. Self-cleaning lint filter.
    - c. Unbalanced-load compensator.
    - d. Inlet Hoses: Minimum length 60 inches (1525 mm).
    - e. Drain Hoses: Minimum length 48 inches (1220 mm).
    - f. Self-leveling legs.
    - g. Automatic dispenser for bleach, fabric softener and detergent.
    - h. Spin-cycle safety switch.
    - i. End-of-cycle signal.
    - j. Extra-rinse option.
    - k. Delay-wash option.
    - l. Electronic temperature control.
    - m. Water levels automatically set.
  8. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
  9. Water-Efficient Clothes Washer: Provide clothes washer with modified energy factor greater than or equal to 2.0 and water factor less than 5.5.
  10. Appliance Color/Finish: Metallic Carbon
- B. Clothes Dryer: Complying with AHAM HLD-1.
1. Type: Freestanding, frontloading, electric unit as indicated in drawings, #7 in Equipment List, page A102.
  2. Dimensions:
    - a. Volume: As indicated in drawings.
    - b. Height: 34-1/2 inches (876 mm).
  3. Drum: Perforated stainless steel
  4. Controls: Touch-pad controls for drying cycle, temperatures, and fabric selectors.
  5. Electric Power: As indicated in drawings.
  6. Features:
    - a. Removable lint filter.

- b. Electronic temperature and moisture-level-sensor controls.
- c. End-of-cycle signal.
- d. Interior drum light.
- e. Self-leveling legs.
- f. Antibacterial cycle.
- g. Auxiliary drying rack.
- h. Built-in electrical power fuse.
- i. Appliance Color/Finish: Metallic Carbon

## **2.5 GENERAL FINISH REQUIREMENTS**

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.
- C. Examine walls, ceilings, and roofs for suitable conditions where equipment will be installed.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install appliances according to manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- D. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.

### **3.3 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
  - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After installation, start units to confirm proper operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- B. An appliance will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.4 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION 113100

**SECTION 124813  
ENTRANCE FLOOR MATS AND FRAMES**

**Part 1 General**

**1.01 Summary**

- A. This section includes the following types of entrance flooring systems:
  - a. Floor Grids & Frame Assemblies
- B. Related Sections: The following sections contain requirements related to this section:
  - a. Grouting frames into recess; refer to sections 03300 "Cast-In-Place Concrete".

**1.02 References**

- A. American Society for Testing and Materials (ASTM)
- B. The Aluminum Association

**1.03 Submittals**

- A. Product data for each type of floor grid and frame specified, including manufacturer's specifications and installation instructions.
- B. Shop drawings in sufficient detail showing layout of grid and frame specified including details indicating construction relative to materials, direction of traffic, spline locations, profiles, anchors and accessories.
- C. Samples for verification purposes: Submit an assembled section of floor grid and frame members with selected tread insert showing each type of color for exposed floor grid, frame and accessories required.
- D. Maintenance data in the form of manufacturer's printed instructions for cleaning and maintaining floor grids.
- E. Flammability in accordance with ASTM E648, Class I, Critical Radiant Flux, minimum 0.45 watts/m<sup>2</sup>.
- F. Slip resistance in accordance with ASTM D-2047-96, Coefficient of Friction, minimum 0.60 for accessible routes.
- G. Standard rolling load performance is 500 lb./wheel (load applied to a solid 5" x 2" wide polyurethane wheel, 1000 passes without damage).
- H. Single source responsibility: Obtain floor grids and frames from one source of a single manufacturer.
- I. Utilize superior structural stainless steel Type 304 components.

**1.05 Delivery, Storage and Handling**

- A. Deliver materials to the project site ready for use and fabricated in as large sections and assemblies as practical, in unopened

original factory packaging clearly labeled to identify manufacturer.

#### **1.06 Project Conditions**

- A. Field measurements: Check actual openings and depth for grids by accurate field measurements before fabrication. Record actual measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.
- B. Coordinate frame installation with concrete construction to ensure recess and frame anchorage are accurate and that the base is level and flat. Defer frame installation until building enclosure is complete and related interior finish work is in progress.

### **Part 2 Products**

#### **2.01 Manufacturers**

- A. Provide basis of design as indicated in Finishes legend ID101 or equivalent.

#### **2.02 Materials**

- A. Stainless steel - Type 304 (316 available) stainless steel for surface wires and U-clip support structures.

#### **2.03 Floor Grids**

- A. Model and Description - stainless steel grid 2 with tread inserts
- B. Material: Type 304 stainless steel
- C. Depth: 1 1/8" (28.57mm), verify with existing floor recess
- D. Accessories:
  - a. Wires to be .140" (3.55mm) x .125" (3.175mm) connected utilizing a U-clip support structure and spaced .187 (4.75mm) apart.
  - b. Carpet Receivers: stainless steel to accommodate a 1 1/4" wide carpet, 1/4" apart. Verify with spacing of existing system. Spacing of
  - c. Capacity: 500 lb./ wheel rolling loads (load applied to a solid 5" x 2" wide polyurethane wheel, 1000 passes without damage).

#### **2.04 Tread Insert Options**

- A. Insert Carpet shall meet the Carpet and Rug Institute's standard for indoor air quality.
- B. Fibers: minimum of 100, 12 mil monofilament fibers per square inch
- C. Finish: solution-dyed nylon.
- D. Color: as indicated in drawing or match
- E. Construction: Each carpet fiber and monofilament shall be fusion-bonded to a rigid two-ply backing to prevent fraying and supplied in continuous splice-free lengths.

- F. Anti-static carpet fiber shall contain antimicrobial additive and be treated with Scotchgard® to reduce soiling.
- G. Carpet weight: 33-oz./yd<sup>2</sup>.

## **2.05 Grid Frames**

- A. SSDP- 1-1/8" Stainless Steel Deep Pit Frame w/ drain pan
- B. Type 304 stainless steel with 1/8" (3.2mm) exposed surface at grid perimeter.
- C. Support structure to be comprised of adjustable height
  - a. Aluminum support feet and legs spaced no more than 12" (609.6mm) on center.
  - b. Maximum overall depth of grid and framing system to be no more than 7" (177.8mm) deep.
  - c. Drain pan to be .050" (1.3mm) Aluminum or Stainless Steel with general purpose PVC drain with stainless steel strainer.
  - d. Rolling load capacity: 300 lb. /wheel.

## **2.05 Lock Down Mechanism**

- A. HL - Hidden Lock Down shall be a 1 1/4" (31.75 mm) x 1 1/4" (31.75mm) x 1/8" (3.175mm)
- B. Type: 304 stainless steel w/hold down plate to secure Gridline to concrete surface.

## **Part 3 Execution**

### **3.01 Examination**

- A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
  - a. Do not proceed until unsatisfactory conditions have been corrected.

### **3.02 Preparation**

- A. Manufacturer shall offer assistance and guidance to provide a template of irregular shaped grid assemblies to ensure a proper installation.
  - a. Stainless steel grids are not field adjustable, ordered stainless steel grids with optional factory template service.

### **3.03 Installation**

- A. Install the work of this section in strict accordance with the manufacturer's recommendations.
- B. Set grid type at height recommended by manufacturer for most effective cleaning action.
- C. Coordinate top of grid surfaces with bottom of doors that swing

across to provide ample clearance between door and grid.

- D. Install flooring system slate perpendicular to traffic moving through the entry.

### **3.04 Cleaning**

- A. Clean the tread surface and recessed well as frequently as possible to reduce the effects of accumulated soiling that may hinder performance and lifetime.

### **3.05 Protection**

- A. After completing required frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses, and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and project is near time of substantial completion.
- B. Defer installation of floor grids until time of substantial completion of project.

End of Section



**SECTION 23 81 00**  
**DECENTRALIZED UNITARY HVAC EQUIPMENT**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies split-systems.
- B. Definitions:
  - 1. Energy Efficiency Ratio (EER): The ratio of net cooling capacity is Btu/h to total rate of electricity input in watts under designated operating conditions (Btu hour/Watt).
  - 2. Seasonal Energy Efficiency Ratio (SEER): The ratio of the total cooling output of an air conditioner during its normal annual usage period for cooling in Btu/h divided by total electric energy input in watts during the same period (Btu hour/Watt).
  - 4. Where such equipment is provided in more than one assembly the separated assemblies are to be designed to be used together and the requirements of rating are based upon use of matched assemblies.

**1.2 RELATED WORK**

- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- C. Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT: Requirements for different types of vibration isolators and noise ratings in the occupied areas.
- D. Section 23 07 11, HVAC and BOILER PLANT INSULATION: Requirements for piping insulation.
- E. Section 23 23 00, REFRIGERANT PIPING: Requirements for refrigerant pipes and fittings.
- J. Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.

**1.3 QUALITY ASSURANCE**

- A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Safety Standards: ASHRAE Standard 15, Safety Code for Mechanical Refrigeration.

**1.4 SUBMITTALS**

- A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES
- B. Manufacturer's literature and data:

1. Sufficient information, including capacities, pressure drops and piping connections clearly presented, shall be included to determine compliance with drawings and specifications for split systems.
  2. Unit Dimensions required clearances, operating weights accessories and start-up instructions.
  3. Electrical requirements, wiring diagrams, interlocking and control wiring showing factory installed and portions to be field installed.
- C. Certification: Submit proof of specified ARI Certification.
- D. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required sensible-to-heat-ratio, energy efficiency ratio (EER), and coefficient of performance (COP).
- E. Operating and Maintenance Manual: Submit three copies of Operating and Maintenance manual to Contracting Officer Representative three weeks prior to final inspection.
- F. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.):
- A-A-50502-90..... Air conditioner (Unitary Heat Pump) Air to Air  
(3000-300,000 Btu)
- C. Military Specifications (Mil. Specs.):
- MIL-PRF-26915D-06.....Primer Coating, for Steel Surfaces
- D. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):
- 210/240-08.....Performance Rating of Unitary Air-Conditioning  
and Air-Source Heat Pump Equipment
- 270-08.....Sound Rating of Outdoor Unitary Equipment
- 310/380-04.....Standard for Packaged Terminal Air-Conditioners  
and Heat Pumps (CSA-C744-04)
- 340/360-07.....Performance Rating of Commercial and Industrial  
Unitary Air-Conditioning and Heat Pump Equipment
- 520-04.....Performance Rating of Positive Displacement  
Condensing Units
- E. Air Movement and Control Association (AMCA):

- 210-07.....Laboratory Methods of Testing Fans for  
Aerodynamic Performance Rating (ANSI)
- 410-96.....Recommended Safety Practices for Users and  
Installers of Industrial and Commercial Fans
- F. American National Standards Institute (ANSI):
  - S12.51-02 (R2007).....Acoustics - Determination of Sound Power Levels  
of Noise Sources Using Sound Pressure -  
Precision Method for Reverberation Rooms (same  
as ISO 3741:1999)
- G. American Society of Heating, Refrigerating, and Air-Conditioning  
Engineers (ASHRAE):
  - 2008 Handbook.....HVAC Systems and Equipment
  - 15-10.....Safety Standard for Refrigeration Systems (ANSI)
- H. American Society of Testing and Materials (ASTM):
  - B117-09.....Standard Practice for Operating Salt Spray (Fog)  
Apparatus
- I. American Society of Civil Engineers (ASCE)
  - ASCE 7-10.....Minimum Design Loads for Buildings and Other  
Structures
- J. National Electrical Manufacturer's Association (NEMA):
  - MG 1-09 (R2010).....Motors and Generators (ANSI)
  - ICS 1-00 (R2005, R2008).Industrial Controls and Systems: General  
Requirements
- K. National Fire Protection Association (NFPA) Publications:
  - 90A-09.....Standard for the Installation of Air-  
Conditioning and Ventilating Systems

## **PART 2 - PRODUCTS**

### **2.1 UNITARY AIR CONDITIONERS - GENERAL**

- A. Applicable ARI Standards:
  - 1. Cooling Capacity 39.6 kW (135,000 Btu/h) and More: AHRI 340/ 360.
  - 2. Cooling Capacity Less Than 39.6 kW (135,000 Btu/h): AHRI 210/240.Units shall be listed in the ARI Directory of Certified Unitary Air-Conditioners.
- B. Performance Rating: Cooling capacity of units shall meet the sensible heat and total heat requirements shown in the contract documents. In selecting unit size, make true allowance for "sensible to total heat ratio" to satisfy required sensible cooling capacity.
- C. Machinery Guards: Provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts

regardless of height above the floor. Drive guards may be excluded where motors and drives are inside factory fabricated casings.

- D. Corrosion Prevention: Unless specified otherwise, equipment fabricated from ferrous metals that do not have a zinc coating or a duplex coating of zinc and paint shall be treated for prevention of rust with a factory coating or paint system that will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall be tested for 500 hours. The salt-spray fog test shall be in accordance with ASTM B117 using a 20 percent sodium chloride solution. Immediately after completion of the test, the coating shall show no signs of blistering, wrinkling or cracking, no loss of adhesion, and the specimen shall show no signs of rust beyond 3 mm (1/8-inch) on both sides from the scratch mark.

### **2.3 SPLIT-SYSTEM AIR CONDITIONERS**

- A. Description: Factory assembled and tested, ceiling mounted unit, with an air-cooled remote condensing unit, and field-installed refrigeration piping.
- B. Concealed Evaporator Components:
1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
  2. Insulation: Factory-applied duct liner.
  3. Drain Pans: Galvanized steel, with connection for drain; insulated and complying with ASHRAE 62.1-2007.
  4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
  5. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
  8. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
  9. Fan Motors: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT for multi-tapped, multi-speed motors with internal thermal protection and permanent lubrication.
  10. Disposable Filters: 25 mm (1 inch) thick, in fiberboard frames.
  11. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- E. Ceiling-Mounting, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
3. Drain Pan and Drain Connection: Comply with ASHRAE 62.1-2007.
4. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
6. Fan: Direct drive, centrifugal fan, and integral condensate pump.
7. Fan Motors: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT for multi-tapped, multi-speed motors with internal thermal protection and permanent lubrication.
8. Filters: Disposable, with MERV rating of 7 or higher according to ASHRAE 52.2.

F. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Service valves, fittings, and gage ports shall be brass and located outside of the casing.
2. Compressor: Hermetically sealed scroll with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
3. Compressor motor with manual-reset, high-pressure switch and automatic-reset, low-pressure switch.
4. Refrigerant: R-410A unless otherwise indicated.
5. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with liquid subcooler.
6. Fan: Aluminum, propeller type, directly connected to motor.
7. Motor: Permanently lubricated, with integral thermal-overload protection.
8. Low Ambient Kit: Permit operation down to minus 18 deg C (0 deg F).
9. Mounting Base: Polyethylene.
10. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1-2004, "Energy Standard for Buildings except Low-Rise Residential Buildings."

**2.4 AIR-COOLED REMOTE CONDENSER**

A. Description: Factory tested, assembled and pre wired outdoor unit consisting of cabinet, condensing coils, fans, controls and guards.

B. Components:

1. Casing: Welded galvanized steel frame, galvanized steel removable panels for coil cleaning, hinged access panels to controls, weep holes for water drainage, and mounting holes in base. Service valves, grease fittings, and gage ports shall be brass and located outside of the casing.
2. Refrigerant: R-22 unless otherwise indicated.
3. Refrigerant Coil: Seamless copper tube, with mechanically bonded aluminum fins, complying with AHRI 340/360.
4. Fan: Aluminum, propeller type, swept blades, directly connected to motor, static and dynamically balanced, venturi collars, coated steel fan guards.
5. Motor: Electronically Commutated (EC), permanently lubricated, with integral thermal-overload protection, weathertight slinger over bearings.
6. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1, "Energy Standard for Buildings except Low-Rise Residential Buildings.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.
- B. Unit Support: Install unit level on structural concrete pads on grade. Coordinate wall penetrations and flashing with wall construction. Secure units to support with anchor bolts.
- C. Install wind restraints according to manufacturer's written instructions. Wind restrained vibration isolation roof-curb rails are specified in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.]
- D. Install units level and plumb maintaining manufacturer's recommended clearances and tolerances.
- I. Install compressor-condenser components on equipment supports specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Anchor units to supports with removable, cadmium-plated fasteners.
- K. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 25 mm (1 inch) unless otherwise

indicated. Refer to Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.

- L. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
- M. Install wall sleeves in finished wall assembly weatherproof.

### **3.2 CONNECTIONS**

- A. Verify condensate drainage requirements.
- B. Install condensate drain, minimum connection size, with trap and indirect connection to nearest area drain or to grade.
- C. Install piping adjacent to units to allow service and maintenance.
- I. Ground equipment and install power wiring, switches, and controls for self contained and split systems.
- J. Connect refrigerant piping to coils with shutoff valves on the suction and liquid lines at the coil and a union or flange at each connection at the coil and condenser.
- L. Connect piping with shutoff duty valves on the supply and return side of the coil and unions at all connections and with a throttling valve on the return piping near the coil.

### **3.3 FIELD QUALITY CONTROL**

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections: After installing units and after electrical circuitry has been energized, test units for compliance with requirements. Inspect for and remove shipping bolts, blocks, and tie-down straps. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Remove and replace malfunctioning units and retest as specified above.

### **3.4 INSTRUCTIONS**

Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.

### **3.5 STARTUP AND TESTING**

The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Contracting Officer Representative and Commissioning Agent. Provide a minimum of 7 days prior notice.

### **3.6 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection,

start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

### **3.7 DEMONSTRATION AND TRAINING**

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.
- B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS.

---END---